

DATA PROCESSING SYSTEM FOR THE INTENSITY MONITORING SPECTROMETER
FLOWN ON THE ORBITING GEOPHYSICAL OBSERVATORY-F (OGO-F) SATELLITE

by

Allan G. Cronin, James R. Delaney

Analysis & Computer Systems, Inc.
113 Terrace Hall Avenue
Burlington, Massachusetts 01803

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ABSTRACT

This report discusses the system developed to process digitized telemetry data from the intensity monitoring spectrometer flown on the Orbiting Geophysical Observatory-F (OGO-F) satellite. Functional descriptions and operating instructions are included for each program in the system. The Automated Production Logging System developed and implemented during this report is also discussed.

FOREWORD

The design and implementation of the data processing systems herein are the result of analytical research performed for the Solar Ultraviolet Branch of the Aeronomy Laboratory, Air Force Cambridge Research Laboratories, Air Force Systems Command, Hanscom Field, Bedford, Massachusetts.

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1.0 INTRODUCTION

This report describes the data processing system designed to analyze digitized data acquired from a spectrometer experiment flown on the Orbiting Geophysical Observatory (OGO-F) satellite. The report focuses upon the logical procedures and techniques developed to perform data reduction, statistical analysis and to generate data displays. No attempt is made to analyze the scientific content of experiment results. The illustrations and plots herein are intended only to be graphical adjuncts to the textual description of the system.

The authors have paraphrased from several unpublished documents and memorandums received from research personnel during the development, implementation and production phases of the effort.

2.0 SCOPE OF THE DATA PROCESSING SYSTEM

The overall effort for the processing of the OGO-F data involved three phases. The first phase consisted of the design, development and verification of the computer programming system to reduce and convert the digitized data to the phenomena the experiment was designed to observe. Basically, the primary outputs of this phase were the peak intensity values of definable lines from each processed scan of the six experiment sensors. The program design to accomplish this task was under continuous review during the entire contract to ensure that the most scientifically correct and usable results were obtained. The program was expanded and revised as analyses of the reduced data suggested new or better processing techniques or new avenues of scientific interest to be pursued.

The second phase of the effort was the processing of the digitized data with the programming system developed in phase I. Seven months of scientifically interesting data were acquired. Each acquisition was stored as a file on the digitized tapes. Approximately 2,000 of these files were processed. The outputs from each file were 35mm film of aspect corrected counts versus wavelength for each scan of each sensor, a printout of the counts, wavelengths, collimator position, aspect and time for each frame of data, and punched data cards containing the peak intensities and background levels of predefined lines. The punched card data were ultimately stored on magnetic tapes in chronological order and were the inputs for the third phase of the effort.

Phase three consisted of statistically analyzing and summarizing the peak data from phase II. Various listings and plots were generated and ultimately summarized results for each of the predefined lines were stored on two magnetic tapes.

The three basic phases overlapped in time to a great extent. As the outputs from the production runs were analyzed, modifications and additions to more completely and accurately process the data were made to the programming system. Similarly, as the initial production punched card output was updated to magnetic tape, the programs to reduce, analyze and summarize these data were being designed, coded and verified.

3.0 EXPERIMENT TECHNICAL DESCRIPTION

The experimental study which will utilize measurements from the spectrophotometer instrumented for the OGO-F spacecraft has, as objective, a determination of spectral and temporal variations of photon flux levels (radiated from the entire disk) in the extreme ultraviolet portion of the solar spectrum. Experimental emphasis, reflected in certain instrumental characteristics, is primarily directed toward what might be called an intensity monitoring function rather than a detailed spectroscopic examination. Experimental objectives then are, repetitive, long-term observations, by means of a calibrated, scanning spectrometer having modest spectral resolution of intensity levels of those radiations in the extreme ultraviolet which are of aeronomical interest.

The experimental package contains six collimator-grating spectrometers in a parallel array which provide for an overall spectral scan ranging from 160 Å to 1600 Å. Throughout this wavelength range, the spectrometers have an effective resolving power of the order of 100. By choice of grating constant, each of the six spectrometers covers a different spectral sub-range such that the total range scanned is as indicated above. The six intervals are:

<u>Grating (lines/mm)</u>	<u>Scan Limits (Å)</u>
3600	160-416
2160	267-695
1800	320-832
1500	384-998
1200	480-1248
900	640-1664

These wavelength intervals, with the exception of the extremes, overlap to a considerable extent and as is apparent from the tabulation, gratings 2160, 1800 and 900 1/mm include the interval from 267-1664 Å and gratings 3600, 1500, and 1200 1/mm cover the interval from 160-1248 Å providing two nearly redundant groupings.

Each of the six spectrometers consists of a planar grating, an analyzing slit system (collimator) and a detector plus associated electronics. The entrance aperture of each spectrometer is sufficiently large to allow uniform illumination of each grating for all orientations of the optical axis within $\pm 2^\circ$ from ideal pointing along the mean solar vector. In the case of ideal spacecraft attitude, each point of the six gratings is illuminated at an 86° angle of incidence by solar rays which are 32 arcminutes divergent. This angular divergence generally determines the effective instrumental resolving power and leads to a value of about 100 for radiation from the entire solar disk.

Under illumination, spectra are produced in the respective planes of dispersion of the six planar gratings. Wavelength scanning is accomplished with a six-channel collimator in spatial registration with the six gratings. The collimator drive is actuated by a stepping motor which produces a 12 degree angular scan in 513 discrete steps. Motion of the collimator is equivalent to a scan of diffraction angles by the axial, high-transmission direction of the collimating slit system.

At each step of the scan, dispersed radiation of the appropriate wavelength is transmitted by the collimator while radiation appearing at angles outside the acceptance angle of the slit system is rejected. The finite angular range of acceptance of the collimator contributes to line broadening and, in part, determines the limiting resolution of the system.

A channel electron multiplier (Bendix Channeltron) is located behind the exit slit of each of the six collimator apertures so as to receive the diffracted radiation which is appropriately transmitted at each position of the collimator. The channel multipliers are formed of 2 mm I.D. activated glass tubing bent in a 300 degree circular arc of 2.5 inch diameter. With an overall voltage gradient of 3 kilovolts, the multipliers have a charge gain of approximately 10^8 which easily allows counting of output pulses produced by single photoelectrons generated at the input photocathode. The output terminal of the multiplier is operated at high positive potential and is a.c. coupled directly into an integrated circuit differential amplifier which is located within the area circumscribed by the channel multiplier itself. These output signal pulses are fed, through a gate, to an 18-stage counter from which the stored information is subsequently shifted to the spacecraft data handling system.

Data generated within the experiment which are of direct physical interest are (1) the angular location of the collimator relative to the diffraction gratings--this determines the wavelength for which the collimator transmission is maximum, and (2) the totalized count at a given collimator position for each detector--this determines the relative source intensity (utilizing laboratory information) for various spectral locations.

The collimator is step-driven (513 discrete steps per scan) through a 12 degree angular range (diffraction angles from 58° - 70°) and the step position is tabulated by a position counter which increments one unit for each driving pulse to the motor. The scan proceeds from step 0 to step 513 at which point the direction is reversed to retrace from step 513 to step 0. Normally reversal of the drive direction is accomplished by logic associated with the step-position counter, i.e. reversal is accomplished at steps 0 and 513. Mechanical switches are located at points which are about ten steps beyond the normal angular range to

provide reversing signals and counter reset information in the event of a severe lack of registration between the position counter and the actual mechanical scan position. In addition to the mechanical switches which provide end-of-scan reset information the electronic position counter is compared at points separated by 64 step positions with the output of an optical encoder (sunlight operated). The logic established by the encoder forces the counter into numerical coincidence with the unambiguous step position sensed by the encoder which is mechanically linked to the collimator drive system. Occasional corrections are necessary as the electronic counter may respond to certain spurious pulses (particularly those associated with the impulse commands) and fail to maintain registration with the actual mechanical scan position.

The other measured quantities of interest are the photoelectron counting rates sensed by the detectors. At each of the 513 steps of the wavelength scan, the counter gates are cycled to sample the outputs from all six detectors, in sequence. In the detector electronics, each channel multiplier is followed by a pulse amplifier, the output of which terminates at a triple-input gate. Three amplifier outputs are switched, in sequence, to one eighteen-stage counter while the remaining three are switched to a second, identical counter. The timing pattern for opening and closing the gates is determined by scan and sample logic within the experiment. For each of the 513 collimator positions, there will be six numbers which represent the accumulated count for the associated sampling interval, one number for each of the six spectrometers (one complete scan yields 3078 data points). Note that each step position gives intensity information at six different wavelengths.

Solar Aspect System:

The experimental package performs one additional measurement, that of experiment attitude (two-dimensional) relative to the mean solar vector. A bi-axial solar aspect system with an angular resolution of 1/16 degree is mounted directly beneath the entrance aperture of the spectrometer. Aspect information is shifted to the spacecraft telemetry once every other main commutator frame.

An aspect indicating unit is mounted on the sun-facing panel of the experiment package which will provide a coded readout of the orientation of the x- and z- axes of the package relative to the mean solar vector. The angular resolution of the device is 1/16 degree and the time resolution, derived from alternate main commutator frames, is 288 msec at 8 kilobits. Mechanically, the experiment is mounted with the optic axis parallel to the corresponding axis of the fine sun sensor aboard the spacecraft. This alignment is made with a tolerance of less than 1/4 degree using optical techniques.

The aspect information is presented on the telemetry in sixteen bits. Of these sixteen bits, the first eight derive from the vertical reticle (parallel to the solar paddle x-axis) and the remaining eight from the horizontal reticle (parallel to the solar paddle z-axis). Typical calibration data of binary readout (octal) as a function of angular displacement is given in the following table.

<u>Octal</u>	<u>Angle (degrees)</u>
000	0.032
001	0.096
010	0.544
020	1.056
100	4.128
177	8.160
200	-8.160
300	-4.064
360	-0.992
370	-0.480
376	-0.096
377	-0.032

4.0 FORMAT OF DIGITIZED DATA TAPES

Experiment F-09 has been assigned four adjacent digital words in the spacecraft main frame, namely Words 49, 50, 51, 52. In addition the experiment utilizes two sub-commutator analog words to provide high voltage status information (Words 31 and 62). Two sequential main frames or eight digital words comprise the basic data unit of the experiment and alternate spacecraft frames are ordered in different data formats. Telemetry word and bit usage are as follows:

Frame 1	{	Word 49	Housekeeping data
		Word 50	513-step position counter
		Words 51, 52	18-bit detector pulse counter--Counter No. 1
Frame 2	{	Words 49, 50	Solar Aspect Data
Format 2		Words 51, 52	18-bit detector pulse counter--Counter No. 2.

Frame (Format) 1, Word 49

Bit No. 1	"1"	Always positive--"one"
2	"0"	Counter identification-No. 1
3	Scan Mode	"0"-Long scan; "1" short scan
4	Drive Direction	"1"-0-->513; "0"-513-->0
5	Mode Inversion	"1"-Real time; "0"-data storage
6	Scan and	{ 00-Normal; 10-X4 step
7	Sample Modes	
8	Detector	{ 01-Detector 1
9	Identification Code	
		10-Detector 2
		11-Detector 3
		00-Stepping frame

Frame (Format) 1 - Word 50

Collimator step position - A nine-bit binary code to identify steps 0 to 512 (step 513 is also 0 following 512).

Frame (Format) 1 - Words 51, 52

Pulse Counter No. 1

These two words provide telemetry for an eighteen-bit binary pulse counter which records pulses from Detectors No. 1, 2, and 3.

Frame (Format) 2, Words 49, 50

Bit No. 1	"1"	Always positive - "one"
2	"1"	Counter identification-No. 2
3 Aspect		{ Vertical Reticle - parallel to s/c X-axis
10 Sensor		
11 Aspect		{ Horizontal Reticle - parallel to s/c Z-axis
18 Sensor		

Frame (Format) 2, Words 51, 52

Pulse Counter No. 2

The two words provide telemetry for an eighteen-bit binary pulse counter which records pulses from Detectors No. 4, 5, and 6.

In addition to the four main commutator words, three subcommutator words are stored in the basic frame structure. These are words 97, 98 and 99. The subcommutators have a 128 step cycle. During each step each of the three words is monitoring a different spacecraft or experiment function. The current step (0-127) is encoded in word 65, one of the spacecraft ID words. Since each frame covers a time period of 288MS, a full 128 step subcommutator cycle is 18.43 seconds in the normal mode of operation. Consequently, each subcommutator parameter is updated every 18.43 seconds. The following seven subcommutator parameters were utilized in the analyses of the spectrometer data.

<u>Subcom Word</u>	<u>Code</u>
97-31	HV1 High Voltage Status for Detectors 1, 2, 3
97-62	HV2 High Voltage Status for Detectors 4, 5, 6
98-19	D4
98-20	D5
98-24	A11
98-42	A10
99-65	E29 General Thermistor Temperature

In normal mode operation, the six detector outputs are sampled once per collimator step position and the complete sampling of outputs requires the utilization of eight successive telemetry frames. Since the experiment contains two binary pulse counters, two detector outputs may be sampled in parallel and the internal sampling program selects the pairs - Detectors 1 and 4; Detectors 2 and 5; and Detectors 3 and 6 - with the outputs 1, 2, and 3 switched to Counter No. 1 and outputs 4, 5, and 6 to Counter No. 2.

Consider eight sequential main commutator frames. Following Word 52 in Frame 1, the gate from Detector 1 to Counter 1 is opened. This gate remains open until the beginning of Word 49, Frame 3 when the gate is closed. Data accumulated in Counter 1 during the above period are shifted out during Words 51, 52 of Frame 3 while Words 49, 50 contain housekeeping and collimator position data. At the end of Word 52, Frame 3, the gate is opened from Detector 2 to Counter No. 1 and is held open until Word 49, Frame 5 is reached, at which point accumulated data are shifted to the telemetry. The gate is then switched open for Detector 3 and is held open from the end of Word 52, Frame 5 until the beginning of Word 49, Frame 7 and these data are shifted during Words 49, 50, 51, 52 of Frame 7. An analogous sequence is followed for Detectors 4, 5, and 6 utilizing the intermediate frames, namely Frames 2, 4, 6, and 8. For example, the gate from Detector 4 to Counter 2 is open from the end of Word 52, Frame 2 until the beginning of Word 49, Frame 4, following which period, aspect system and Counter 2 data are shifted out to the telemetry. Following Word 52, Frame 7, all Counter No. 1 data are inhibited and following Word 52, Frame 8, all Counter No. 2 data are inhibited until Frame 9 (or 1), Word 52 and Frame 10 (or 2), Word 52, respectively, at which point the sequence begins over again. In the data inhibit period following Word 52, Frame 8, the collimator is advanced one step. For each detector, the gate is switched open for a duration of two frames less one 4-word shift-out interval, i.e. $288 - 4.5 \text{ msec} = 283.5 \text{ msec}$ sample accumulation time. A collimator step occurs every eight frames or 1.152 sec and a long scan of 513 steps requires 9.85 minutes (a 65-step short scan requires 1.25 minutes).

Figure 4.1 illustrates the basic data record.

DATA FORMAT FOR EXPERIMENTER 9

<u>CHARACTER</u>	<u>REPRESENTATION</u>
1-2+42N	D(33,j) Spacecraft Clock
3-4+42N	D(34,j)
5-6+42N	D(35,j)
7-8+42N	D(65,j)
9-10+42N	D(66,j) Spacecraft ID Words
11-12+42N	D(67,j)
13-14+42N	D(97,j)
15-16+42N	D(98,j) Subcom Words
17-18+42N	D(99,j)
19-20+42N	D(107,j) SAI
21-24+42N	D(129,j) F ₁ Status field
	D(131,j) F ₃ Status field
25-26+42N	D(49,j)
27-28+42N	D(50,j)
29-30+42N	D(51,j) Main Comm Data
31-32+42N	D(52,j)
33-34+42N	D(132,j) Day of Year
35-36+42N	D(133,j)
37-38+42N	D(134,j) Milliseconds of Day
39-40+42N	D(135,j)
41-42+42N	Spare

0 ≤ N ≤ 63 Record #1

64 ≤ N ≤ 127 Record #2

Figure 4.1

5.0 DESCRIPTION OF COMPUTER PROGRAMS AND OPERATING INSTRUCTIONS

Seven computer programs comprise the OGO-F Data Processing System. This section will contain a functional description of each and will describe the procedures for executing each program.

5.1 Programs RDLP and PKGROUP

RDLP and PKGROUP are independent programs. However, they are executed as a two program system. RDLP, among other functions, outputs the peak intensities from each scan of data. PKGROUP analyzes the peaks and attempts to group the peaks from the multiple scans which represent the same line in the spectral range of each sensor.

5.1.1 Functional Description

Program RDLP contains several processing options which are defined via data cards. Among these options are multiple file processing, definition of parameters used in aspect and backlash correction, file selection, time period within a file to be processed selection, plot medium selection (35mm film or paper), scaling of the ordinate selection, listing of aspect corrected or uncorrected sensor counts and creation of a file for the interactive graphics program. The procedures for option selection will be detailed at the end of this section.

The magnetic tape containing the digitized data is searched until the requested file is encountered. File identification information is extracted from the file header record. This information is printed as the first page of the listing and also is written as the first plot frame. Figure 5.1 is an example of the plot frame containing the file identification data.

The data are unpacked one frame at a time until the millisecond of the day time field exceeds the requested start of processing time. The first frame of an eight frame message is located. This frame is identified by the detector index being equal to 0. The next successive seven frames are added to this first frame to comprise a message. A message contains all data acquired at one collimator position of a scan. The type of scan (long or short), scan direction, collimator position and time are noted. The six 18-bit sensor counts are extracted and are converted to counts/second. The three vertical and three horizontal aspect readings are extracted and converted to degrees using a calibration table. The vertical and horizontal aspect angles used in the aspect correction are weighted averages from the three vertical and horizontal components from each of three consecutive messages. The aspect angles for message N are calculated from the components in messages N-1, N and N+1. The components from message N are weighted more heavily than those from messages N-1 and N+1. If any components

contain fill data, the fill data are replaced by the average of legitimate components from the same message. Fill data can result from telemetry transmission problems or from problems during the digitization process.

The scan position is corrected for vertical angle variations and mechanical backlash. Three corrected scan positions are calculated for each message, and one is assigned to each pair of sensor readings with which it is time coincident. Each of the six sensor readings is corrected for horizontal and vertical aspect. The aspect correction is bypassed for any of the sensor readings which contain fill data.

The wavelength for each sensor reading is calculated from the corrected grating position and the appropriate grating constant. If a graphics application file is being created, the time, grating position, six wavelengths, six uncorrected sensor values, six corrected sensor values, vertical and horizontal aspect and the three horizontal and vertical aspect components are written as one 29 word record.

This message by message processing continues until a new long scan is encountered, six short scans have been accumulated or both power supplies are determined to be off. As each message is constructed, the subcommutator position is interrogated. If the position is one of the seven of interest, the value in the appropriate subcommutator word is converted to the desired units and saved.

The scan start and stop time, and direction are saved. The corrected sensor readings are interrogated for eclipse. If any one sensor reading is negative, eclipse is assumed. If 50% or more of the sensor readings are between 5 and 100 counts, eclipse is assumed. If the scan is in eclipse, the power supplies are off or scan contains fewer than 48 messages, the peak identification logic is bypassed.

The aspect corrected sensor values for each sensor are now searched for peak values. A peak is defined by a minimum of three successive increasing intensities followed by a minimum of two intensities less than the highest intensity. Fill data are eliminated from this logic. The peak values, wavelengths and times are saved in arrays. The peak data arrays are sorted so that all peaks are stored by increasing wavelength.

The background intensity is calculated for each sensor in the scan. For short scans, the background is defined as the average or the minimum positive intensity and its adjacent intensities. For long scans, each sensor has unique criteria based on the wavelength spectrum covered by the sensor and the experiment configuration for that sensor. Following is a summary of these criteria.

IC 3600

- (1) Locate the minimum count between 370A-390A.
- (2) Average minimum with preceding and following counts, ignoring fill data.
- (3) Subtract minimum count from all peak values in the scan.

IC 2160

- (1) Locate the minimum count between 645A-665A.
- (2) Average minimum with preceding and following counts, ignoring fill data.
- (3) Subtract minimum count from all peak values in the scan.

IC 1800

- (1) Locate the minimum count between 645A-665A.
- (2) Average minimum with preceding and following counts, ignoring fill data.
- (3) Locate wavelength values and associated counts closest to 745A and 810A.
- (4) Solve exponential decay formula, $I = Ae^{-\lambda x}$, for A and λ using two points from (3).
- (5) From peaks with wavelengths \leq wavelength located in (1), subtract minimum count calculated in (2).
- (6) For peaks with wavelengths \geq wavelength located in (1), calculate I, the background count, from $I = Ae^{-\lambda x}$ where x is the wavelength associated with the peak. Subtract I from peak count.

IC 1500

- (1) Locate minimum count between 645A-665A.
- (2) Average minimum with preceding and following counts, ignoring fill data.
- (3) Locate wavelength values and associated counts closest to 810A and 880A.
- (4) Solve exponential decay formulas $I = Ae^{-\lambda x}$, for A and λ using two points from (3).
- (5) From peaks with wavelengths \leq wavelength located in (1) and from peaks with wavelength \geq 915A, subtract minimum count calculated in (2).
- (6) For remaining peaks, calculate I, the background count, from $I = Ae^{-\lambda x}$ where x is the wavelength associated with the peak. Subtract I from the peak count.

IC 1200

- (1) Locate minimum count between 640A-660A.
- (2) Average minimum with preceding and following counts, ignoring fill data.
- (3) Locate wavelength values and associated counts closest to 810A and 880A.
- (4) Solve exponential decay formula, $I = Ae^{-\lambda x}$, for A and λ using two points from (3).
- (5) From peaks with wavelengths \leq wavelength located in (1) and from peaks with wavelengths $> 915A$, subtract minimum count calculated in (2).
- (6) For remaining peaks, calculate I, the background count, from $I = Ae^{-\lambda x}$, where x is the wavelength associated with the peak. Subtract I from the peak count.

IC 0900

No background count is calculated for this sensor.

The peak intensities in the scan for each sensor are corrected for background. The wavelength of the peak intensity determines whether the constant or exponential background is subtracted for those sensors having both types of background. The peak data, backgrounds, times and wavelengths are written to a disk. The peak data are printed at the end of the listing and also are input to program PKGROUP.

The time, scan position, corrected scan positions, corrected intensities, wavelengths and aspect angles are printed, one line per message. At the end of the printout for a short scan, the summation of all intensity values in the scan for each sensor is printed. For long scans, the summation is performed for each 100A increment covered by the sensor.

After the intensity summations for the last scan in a file have been printed, the subcommutator parameters accumulated during the processing of the file are listed. The parameters from one 128 frame cycle are printed on one line. The time listed is from the frame containing the D4 parameter, which is for first parameter saved from each cycle.

The subcommutator listing is followed by the peak intensity printout. For a file containing long scan data, the peaks selected from one scan are listed on two pages. The peaks are listed in ascending wavelength for each sensor. Peak intensities which had fill data in adjacent messages are noted with asterisks. The time of the peak to a thousandth of an hour, the peak wavelength,

intensity and intensity after background has been subtracted are printed. For short scan data, the printout differs in that peak intensities from six scans are printed. A scan number and background are printed for each short scan peak also.

The plotted data consists of the six spectra from one scan per frame for long scan files and from six scans for short scan files. For long scan data, the 3600, 2160 and 1800 lines/mm sensors are all plotted with scaling from 100A to 900A. The 1500, 1200 and 900 lines/mm sensors are all scaled from 400A to 1800A. This scaling facilitates the comparison or overlapping segments of the spectra. The ordinate scaling of the intensity values is a log base 10 representation with a range of 10^2 to 10^5 or 10^1 to 10^4 . The abscissa scaling for short scan data is determined from the minimum and maximum wavelengths in the six scans being plotted, and consequently varies slightly from frame to frame.

The constant and exponential background lines for each section of each spectrum are also plotted on the long scan frames. The horizontal and vertical aspect angles are plotted atop the 3600 lines/mm sensor on a -2° to $+2^\circ$ linear scale for both long and short scans. The ordinate range corresponds to the highest log decade from the intensity scaling. The time in hours, minutes and seconds is printed below the abscissa for the first and last data samples in the frame. Figure 5.2 is an example of a long scan plot frame. Figure 5.3 is an example of a short scan plot frame.

At the conclusion of an execution of program RDLP, one or more files of peak intensity data have been created and stored on disk. One file exists for each file processed from the OGO-F digitized data tape. These files are processed by program PKGROUP which normally is executed at the termination of program RDLP. This dual execution eliminates the necessity of saving the file output from RDLP. The control card requirements for this dual execution are explained at the end of this section.

The function of program PKGROUP is to group peak data representing the same predefined lines from the several spectral repetitive scans in a file. The grouping criteria are based on the closeness of the associated wavelength of a peak to predefined wavelengths and on the closeness of the peak intensity relative to the intensity of a major line from the same scan as the peak. Peaks which do not meet minimum standards are eliminated from further analyses. Peak intensities which vary significantly from the peaks representing the same line from other scans are statistically eliminated also. The relative intensity criterion does not apply to peaks from short scan files since in most cases the part of the spectrum investigated in a short scan does not include the major lines found in the complete sensor scan traversal.

The researcher has defined between 30 and 40 lines of interest for each of five of the six sensors. The 900 lines/mm sensor data does not undergo the peak grouping analyses. Figure 5.4 lists the wavelengths and relative intensities for each sensor. The relative intensities are based on the ratio of the intensity of a given line to the intensity of one of the high amplitude lines in the part of the spectrum analyzed by the sensor. The following table lists the wavelength of the peak used for each sensor.

<u>Sensor</u>	<u>Wavelength</u>
3600	304A*
2160	302A*
1800	608A
1500	608A
1200	608A

* Both major peaks represent the same line. The difference is due to wavelength calculation inadequacies.

These wavelengths and relative intensities are stored in arrays in program PKGROUP. The long scan data and short scan data are analyzed differently, so two separate descriptions will be given.

A typical long scan file contains eight to ten scans. For each defined peak, the time, scan number, peak intensity, and peak intensity after background subtraction are read into arrays for each sensor. Consequently, all peaks in the file from one sensor are stored in one large array. Once all the peak data for the file has been stored, the analysis is performed on a sensor by sensor basis. Within a sensor, each scan undergoes the following processing.

If the scan is a backward scan, 2A are added to each predefined wavelength and to the predefined major peak. A search is made for the major peak in the scan data. A peak within $\pm 5A$ of the predefined major peak must be found, or the data from the sensor for the present scan is not included in the analysis. If the major peak is found, its intensity after background subtraction is saved to calculate the relative intensities of the other peaks in the scan.

The wavelength of each peak in the scan is compared to the wavelengths of the predefined peaks for the sensor. If the wavelength of the peak is within $\pm 3A$ (3600 sensor) or $\pm 4A$ (2160, 1800, 1500, 1200 sensors) of a predefined wavelength, the peak parameters are added to the group for that predefined wavelength. Because of the closeness of some of the predefined peaks, a peak from the data may be assigned to more than one predefined group using this gross criteria. Also, more than one peak from a

scan may be assigned to the same predefined line. To accommodate both situations, a measurement of closeness to a predefined peak is assigned each peak from the data. This measurement takes into account both the wavelength and relative intensity values of the peak from the data. The relative intensity is weighted roughly four times greater than the wavelength criteria. If more than one peak from a scan is assigned to the same predefined wavelength, the one having the largest measurement of closeness is tentatively assigned to the predefined wavelength. If the same peak is assigned to two predefined wavelengths and, if in both cases this peak has the greatest measurement of closeness to both predefined wavelengths from all peaks in its scan, the peak is assigned to that predefined wavelength for which its measurement of closeness is larger. The peak is removed from the second predefined wavelength. If any other peaks from the same scan had also been assigned to the second predefined wavelength, the one with the largest measurement of closeness is assigned to that wavelength. This scheme eliminates the possibility of the same peak being assigned to two predefined wavelengths while ensuring that a given peak is assigned to the predefined wavelength to which it is best suited based on the wavelength and relative peak intensity criteria.

There also will be peaks which simply do not meet the $\pm 3A$ or $\pm 4A$ criteria for any predefined wavelengths. These peaks are eliminated from any analysis and are listed as a group at the end of the printout.

When all peak data from all scans in the file for a given sensor have been appropriately analyzed and uniquely assigned to the predefined wavelengths, the peaks in each predefined wavelength group undergo additional statistical analyses. The group intensity mean is calculated. Any peaks more than 1.1 standard deviations from the group intensity mean and also more than 35% from the mean are eliminated.

Short scan peak data undergo similar analyses. However, relative intensity is not calculated for short scan data. Consequently, the measurement of closeness criterion is based solely on the closeness of the data peak wavelength to the predefined wavelength. Also, the allowable variation from the group intensity mean is increased to 1.2 standard deviations. If a given predefined wavelength has fewer than eight peaks assigned to it from the entire file, the 35% from the group mean criteria is also used.

For each predefined wavelength, the wavelength, relative intensity, group intensity mean before any peaks are rejected, group intensity mean after rejection and the standard deviation are printed. This summary is followed by the time, calculated wavelength, peak intensity, calculated relative intensity, scan

direction and reason for rejection if applicable for each peak assigned to the predefined wavelength.

For each file of data processed by PKGROUP, a BCD card image file is created. The first card image contains file identification data. One or more cards images are written for each predefined wavelength. The exact number is determined by the number of peaks assigned to the wavelength. For each peak, the time, peak intensity after background subtraction, relative intensity and peak intensity before background subtraction are written. For short scan data, the relative intensity is always 0. These card image files are stored on magnetic tape in chronological order.

5.1.2 Operating Instructions

Programs RDLP and PKGROUP are independent programs. However, if peak grouping is desired, the two programs can be executed in the same computer run. RDLP is executed first and creates the data file read by PKGROUP. This dual execution eliminates the necessity of saving the intermediate data file created by RDLP. If RDLP processes multiple files, PKGROUP processes the data from all of the files. This explanation assumes a basic understanding of the AFCRL CDC 6600 system control cards. Complete descriptions of these cards can be found in the AFCRL CDC 6600 users' guide.

The structure of the complete deck for compilation and execution consists of five sections. Each section is terminated by an EOR card (7/8/9 punched in card column 1). The first section contains the system control cards which perform functions such as compiling and executing the programs, requesting specific magnetic tapes and defining computer core and time requirements. The second section consists of the RDLP Fortran card deck. The third consists of data cards read by program RDLP. These cards contain program options and user definable variables used in aspect and backlash correction. The fourth section is the PKGROUP Fortran card deck. The fifth section is the data cards read by program PKGROUP. These are the predefined wavelengths and relative intensities.

5.1.2.1 System Control Cards

Before using the AFCRL computer center CDC 6600, it is necessary to obtain an account number. Any users running with this number must be in the systems users' name library or attempted runs will abort because of the unrecognizable name on the job card. Also be sure that any magnetic tapes to be processed are submitted with the program deck. Refer to Figure 5.5 for this discussion. The cards in the system control cards section are bracketed by I.

Figure 5.6 shows the two cards which must be submitted in the front of the punched card deck. The 6600 input card will be as shown. The only differences would be the input tape number and an increase of 250 seconds for each additional file processed beyond the first. The plot card is also standard. The estimated number of frames should be increased by 30 for each additional file processed in a multi-file run.

Card #3, the blue job ID card, also requires an increase in the time field (T250) by 250 seconds for each additional file. The account number (7276) will be the one assigned by the computer center.

Card #5 need be modified only by replacing the XXXX portion of (OGFXXXX) with the appropriate tape number. Note that the system control cards are terminated with an EOR card.

5.1.2.2 RDLF Fortran Card Deck

The RDLF Fortran Card Deck (II on Figure 5.5) begins with the program card for the main routine, RDLFY, and terminates with the END card from the last subroutine, LBCDI. This last END card must be followed by an EOR card.

5.1.2.3 RDLF Data Cards

Twenty data cards are required for processing one file of digitized data. Each additional file processed during one program execution requires two additional data cards. This section is III on Figure 5.5.

<u>Card #</u>	<u>Card Columns</u>	<u>Field</u>	<u>Format</u>	<u>Description</u>
1	1-80	Plot ID	8A10	A free formatted field. The data appears at the beginning and end of the plots. User Name, laboratory and account number should be included.
2	1-5	No. of Files to be processed	I5	Low order digit must be in Column 5.
3	2	Variable Number K1	I1	Always 1
	3-31	β_o in Radians	F29.18	Currently 1.00077
4	2	Variable Number K2	I1	Always 2
		δ Radians/Step	F29.18	Currently 0.00040771
5	2	Variable Number K3	I1	Always 3
	3-31	α_o in Radians	F29.18	Currently 1.501
6	2	Variable Number K4	I1	Always 4
	3-31	Vertical Zero	F29.18	Currently 0.0
7	2	Variable Number K5	I1	Always 5
	3-31	Radian Conversion	F29.18	Currently 57.2958
8	2	Variable Number K6	I1	Always 6
	3-31	Backlash Factor	F29.18	Currently 12.7
9	2	Variable Number K7	I1	Always 7
	3-31	Scan Position Correction	F29.18	Currently 0.0
10	2	Variable Number Vertical Aspect	I1	Always 8
	3-31	Correction K8	F29.18	Currently 4.0
11	2	Variable Number Vertical Aspect	I1	Always 9
	3-31	Correction K9	F29.18	Currently 1.0
12	1-2	Variable Number Vertical Aspect	I2	Always 10
	3-31	Correction K10	F29.18	Currently 4.0

<u>Card #</u>	<u>Card Columns</u>	<u>Field</u>	<u>Format</u>	<u>Description</u>
13	1-2	Variable Number	I2	Always 11
	3-31	Vertical Aspect Correction K11	F29.18	Currently 2.0
14	1-2	Variable Number	I2	Always 12
	3-31	Vertical Aspect Correction K12	F29.18	Currently 1.0
15	1-2	Variable Number	I2	Always 13
	3-31	Horizontal Aspect Correction K13	F29.18	Currently 0.25
16	1-2	Variable Number	I2	Always 14
	3-31	Horizontal Aspect Correction K14	F29.18	Currently 0.0
17	1-2	Variable Number	I2	Always 15
	3-31	Vertical Aspect Correction K15	F29.18	Currently 0.3279
18	1-2	End of Variables Switch	I2	Always 21
19	1-30	Plot ID Data	5A6	File Description for Plots <u>Ex:</u> "Tape ØGF200 File 4"
20	1-2	File # to be processed	I2	Position of file on Input Tape.
	5-14	Listing Start Time	F10.3	Time in seconds of day. Standard listing will not begin until this time is exceeded. Set to 0.0 usually.
	17-26	Listing Stop Time	F10.3	Time in seconds of day. Standard listing terminates when this time exceeded. Usually set to 99999.0
	29-38	Plotting Start Time	F10.3	Same as 5-14
	41-50	Plotting Stop Time	F10.3	Same as 17-26
	54	Plot Medium	I1	2 for Paper Plot 3 for 35MM Film Plot
	55-59	Numerical Portion of Input Tape Label	I5	If Tape No. is ØGF1960, punch 1960 in Cols. 56-59

<u>Card #</u>	<u>Card Columns</u>	<u>Field</u>	<u>Format</u>	<u>Description</u>
	62-64	Log Scaling Option	I3	10 for $10^1 - 10^4$ 100 for $10^2 - 10^5$
	66-67	Uncorrected Data Option	F2.0	1. for listing uncorrected sensor data. 0. otherwise.
	69-70	Peak Determina- tion Option	F2.0	1. for peak determination. 0. otherwise.
	72	Graphics File Option	I1	1 if graphics file is to be created. Blank otherwise.

Data cards 3 through 17 contain 15 variables used in various conversion and correction routines. Following is a summation of the mathematical formulas in which they are used. They will be referenced as K1 through K15.

Variables K1 through K7 are used in the routine to correct the scan position (SCP) for angle variations and mechanical backlash. Three corrected scan positions (CWP) are generated for each SCP. The three CWP's are for sensors 1800 + 3600, 900 + 1500 and 2160 + 1200. The formula is:

$$CWP_x = \frac{1}{K2} \left(\text{ARCSIN}(\text{SIN}(K3) - \text{SIN}(K3 - \frac{\text{VERG}_x}{K5} + K4) + \right. \\ \left. \text{SIN}(K1 + K2(\text{SCP} + K6(1 - \text{CMK}))) - K1) + K7 \right)$$

where,

$$X = 1, 2, 3$$

VERG_x = Vertical Aspect Angle for Sensor Pair X

CMK = 0 for Backward Scans
 = 1 for Forward Scans

$K1 = \beta_0$ in Radians

$K2 = \delta$ Radians/Step

$K3 = \alpha_0$ Radians

$K4$ = Vertical Zero

$K5$ = Angular Degrees to Radians Conversion Constant

$K6$ = Mechanical Backlash Correction in Scan Positions

$K7$ = Arbitrary

Variables K8 through K12 were used in the preliminary vertical aspect correction coefficient routine. However, they became superfluous when the routine was modified. All final production runs were made with the modified logic. The modified version uses only one of the variables read from data cards. The coefficient formula is:

$$\text{VERC}_x = 1.0 / (1.0 + K15(\text{VERG}_x))$$

where,

$$X = 1, 2, 3$$

VERC_x = Vertical Aspect Correction Coefficient for Sensor Pair X,

VERG_x = Vertical Aspect Angle for Sensor Pair X,

$$K15 = 0.3279$$

Variables K13 and K14 were used in the Horizontal Aspect Correction Coefficient routine. The horizontal correction coefficient formula is:

$$\text{HORC}_x = 1.0 + K13 \left(\frac{(\text{HORG}_x)^2 - 1.0}{3 - (\text{HORG}_x)^2} \right) + K14$$

where,

X = 1, 2, 3

HORC_x = Horizontal Aspect Correction Coefficient for Sensor Pair X,

HORG_x = Horizontal Aspect Angle for Sensor Pair X,

K13 = 0.25

K14 = 0.0.

Cards 19 and 20 are repeated for each additional file processed during this execution. The last data card must be followed by an EOR card (7/8/9 multi-punched in column 1).

5.1.2.4 PKGROUP Fortran Card Deck

The PKGROUP Fortran Card Deck (IV on Figure 5.5) begins with the program card for the main routine, PKGRP, and terminates with the END card from the last subroutine, GROUP. This last END card must be followed by an EOR card.

5.1.2.5 PKGROUP Data Cards

The data cards for program PKGROUP consist of one card for each predefined wavelength as defined by the researcher. Although the number of predefined wavelengths varies for each sensor, a standard 40 cards are anticipated for each of the five sensors. Blank cards must be placed after the last legitimate wavelength card for any sensor with fewer than 40 predefined peaks to bring the total for that sensor to 40 cards. The following table shows the number of blank cards needed for each sensor and the correct ordering of the cards.

<u>Sensor</u>	<u>Cards</u>	<u>Predefined Wavelengths</u>	<u>Blank Cards</u>
3600	1-40	40	0
2160	41-80	30	10
1800	81-120	33	7
1500	121-160	33	7
1200	161-200	33	7

Within a sensor group, the cards must be in ascending order by wavelength. Columns 1-9 of each card contain the relative intensity in the form xxx.xxxxx. Columns 10-13 contain the corresponding wavelength number which must have its most significant digit starting in column 10.

The 200th card must be followed by an EOR card and an EOF card (6, 7, 8, 9 multi-punched in column 1).

5.1.2.6 Output From Programs RDLP And PKGROUP

The printout from a dual execution contains for each file of data the file identification data, the variables from the data card input to RDLP, the scan by scan listing of the sensor data, the subcommutator data and the peak listing. Following the above printout for the last file processed is the listing of peaks grouped by predefined wavelength for each file processed.

The plotted data consists of the file identification frame followed by one frame per long scan or by one frame per six short scans. Each frame contains a plot for all six sensors. For a multi-file processing execution, the plotted data for each file is preceded by a file identification frame.

The punched card data consists of a file header card followed by a variable number of cards containing the parameters for each peak grouped from the file. Multi-file processing executions will generate one of these decks for each file processed. However, the cards will be punched as one large deck with the file identification cards separating files.

5.2 Background Application Program

The punched card data from program PKGROUP were stored on magnetic tape. The approximately 3,000 files processed successfully were stored on nine tapes. Within a long scan file 169 variable length records were written. The size of the record was determined by the number of peaks from the file, grouped to a given predefined wavelength. Each short scan file contained 50 records since ten predefined lines accommodated all possible ranges of the 16 types of short scans. The files were stored in chronological order.

The following phases of analyses involved summarizing and plotting peak data for each predefined wavelength from multiple files. The parameter of interest to the researcher was the peak intensity after background subtraction. The criteria for background definition had been much more involved for long scan files than it had been for short scan files. For long scan files predefined wavelength ranges were analyzed for the best background definition. Some parts of the spectrum had background defined as an exponential function. For short scan files the background was defined simply as the minimum sensor intensity within each scan. Since both long scan and short scan data were to be part of the same analyses, it was necessary to standardize the background definition. The approach was to replace short scan backgrounds

with averaged long scan backgrounds from chronologically close files.

For a given predefined wavelength in a short scan file, the background levels for the same sensor and wavelength from the five preceding and the five following long scan files were averaged. This average background replaced the preliminary background for all peaks at that wavelength in the short scan file. A new peak intensity after background subtraction was calculated for each peak in the short scan files. New magnetic tapes were created with the altered short scan data. The long scan data was not modified. All succeeding plot and statistical analyses programs used these newly created magnetic tapes.

5.3 Peak Intensity List Program

The Peak Intensity List Program prints the sensor, wavelength, average background and time, peak intensity before and after background subtraction and relative intensity for each peak for control card definable sections of one or more of the magnetic tapes containing peak data. Data selection options consist of a start and stop Julian day and hour, long and/or short scan files, individual or all five sensors and number of tapes to process. The deck setup for execution is as follows:

<u>Card #</u>	<u>Column</u>	<u>Description</u>
1		Orange or yellow 6600 input card. Core Memory = 50K C.P. = 300 seconds/tape P.P. = 300 seconds/tape Tape 1 = First Tape Tape 2 = Second Tape, if applicable
2		DEL01, CM50000, T300, TP2. 7276 Delaney
3		FTN.
4		Request, Tape 1, HY. (Tape #/Noring/Delaney)
5*		Request, Tape 2, HY. (Tape #/Noring/Delaney)
6		LGO.
7		EOR Card (7/8/9 in Column 1)
8		:
:		Fortran Card Deck
:		:
:		:
:		EOR Card

*If processing two tapes

<u>Data Cards</u>	<u>Column</u>	<u>Description</u>
1	1-2	-1 = Process all Sensors 1 = 3600 Sensor 2 = 2160 Sensor 3 = 1800 Sensor 4 = 1500 Sensor 5 = 1200 Sensor
	3-4	Number of tapes to be processed
	5-6	-1 = Process Long and Short Scans 0 = Process Short Scans only 1 = Process Long Scans only
	10-16	Start time for processing in Julian day, hour and hundredths of hour Ex: JUN 29 at 3.70 hours = 1790370
	20-26	Stop time for processing in Julian day, hour and hundredths of hour
2	1-9	Relative Intensity } For predefined Wavelength } Wavelengths
...	10-13	
...		
201		
202*	2-8	Start time for processing for second tape if applicable
	12-18	Stop time for processing for second tape if applicable
203	1	7/8/9
204	1	6/7/8/9

*Only needed if second tape being processed

A second parameter for each of the predefined wavelengths used for the peak intensity grouping analysis was the standard relative intensity of each predefined peak to one of the major peaks in the section of the spectrum covered by the sensor. The major peak for each sensor was chosen for its consistent identification based on amplitude and positioning within a scan sweep. A secondary major peak was also chosen in the event that the primary major peak was not identifiable because of noise or fill data. The relative intensity for each predefined wavelength for a sensor was simply the ratio of the peak intensity of that line to the peak intensity of the major line. The standard relative intensity was determined by averaging the actual ratios from several files of data. This relative intensity criteria added a second dimension to the peak grouping logic which was based on the data from the scan in which a peak was recorded. Program OGOREL was designed to statistically compare calculated relative intensities from many long scale files to the standard relative intensity for each predefined wavelength.

Program OGOREL utilizes the peak amplitude data from the peak grouping analyses. For long scan files, the calculated relative intensity is one of the parameters stored for each peak. OGOREL selects the data from magnetic tape from long scan files only since the relative intensity is not calculated from short scan data. A maximum of 100 long scan files can be accommodated. The relative intensities and times for all peaks for each predefined wavelength for all long scans are stored by sensor and predefined wavelength. Thus, if 50 long scan files are read, each with three peaks at a given predefined wavelength, a total of 150 relative intensities are used for that predefined wavelength in this analysis.

The accumulated relative intensities for each line undergo the following processing. Any relative intensities which are less than one tenth or greater than fifty times the standard relative intensity for the line are eliminated. This gross filtering rejects data from scans where the major peaks are ill defined, and consequently the relative intensities from that scan are distorted. The estimated standard deviation is calculated for the remaining relative intensities by:

$$ESD = \sqrt{\frac{\sum_{i=1}^N (X_i - X_0)^2}{N-1}}$$

where,

ESD = Estimated Standard Deviation for the line

N = Number of relative intensities

X_0 = Mean Relative Intensity

Any relative intensities outside ± 1.1 (ESD) of the mean are rejected, and the mean is recalculated. The sensor, wavelength, standard relative intensity, number of samples, average relative intensity before any samples are rejected and average relative intensity after rejection are printed. Each sample and its time is then listed. Those eliminated by the gross filter are flagged with a dollar sign; those eliminated by the standard deviation criterion are flagged with an asterisk. At the end of the analyses, a summary is listed for each line for each sensor. The wavelength, standard relative intensity, calculated mean relative intensity after rejection, the % difference between the two and the number of samples in the analyses are printed for each predefined line.

The deck setup for an execution of OGOREL is as follows:

<u>CARD</u>	<u>DESCRIPTION</u>
1	Orange or yellow 6600 input card. Core Memory = 114K C.P. = 180 seconds P.P. = 500 seconds Pages = 100 Tape 1 = Tape # for peak data
2	DEL01, T180, CM114000, TP01. 7276 Delaney
3	FTN.
4	REQUEST, TAPE1, HY. (TAPE #/NORING)
5	SETCORE.
6	LOAD, LGO.
7	EXECUTE.
8	7/8/9 IN COLUMN 1
9	OGOREL FORTRAN CARD DECK
.	.
.	.
.	.
	7/8/9 IN COLUMN 1
	The 200 predefined peak and standard relative intensity intensity cards as described in Section 5.1
	7/8/9 IN COLUMN 1
	6/7/8/9 IN COLUMN 1

5.5 Peak Plot Program

The peak plot program processes the peak data after the background has been subtracted. Its purpose is to illustrate the peak amplitude profile for each predefined line over a variable time period. Both long scan and short scan files are utilized. A plot is generated for each of the 169 wavelengths. Five sets of plots are stacked vertically on one plot frame to reduce the plotter requirements. The time period selected is an input variable, but practically ranges from two to four day periods. For a program execution, all abscissa scaling is the same. The ordinate scaling for each of the 169 lines is control card definable. Either 35mm film or paper plots can be requested via data card option.

The magnetic tape containing the requested peak data is searched until the first file within the desired time frame is encountered. The peak intensity after background subtraction and the time is extracted from all peaks and stored by predefined wavelength. The sensors are plotted in order by descending grating lines/MM. Within each sensor, the data are plotted by ascending wavelength, five per frame. The first wavelength of a sensor generates a new plot frame.

Each frame contains sensor, wavelength, and time period identification. A vertical line is drawn at the 0 hour of each day. Each of the five abscissas are labelled depending on the scaling chosen for each wavelength. Each peak value for a wavelength is plotted as an individual point. Short scan data can usually be differentiated from long scan data because of the high density of points clustered together. If a value exceeds the ordinate scaling limit, it is entered in the plot above the one for its wavelength with ordinate position determined by the scaling for its wavelength. It will not be confused with data from the upper plot since each successive plot alternates the two characters, "X" and "O". Consequently, if a particular plot is utilizing the symbol "X", all of its values in the plot above it will be "X"'s in a plot with predominately "O" symbols. Values in the fifth or uppermost plot of a frame which exceed that plot's maximum are not plotted to avoid abnormal termination of the program execution. Figure 5.7 is an example of a peak plot frame.

Following is the deck setup for the peak plot program.

<u>Card</u>	<u>Column</u>	<u>Description</u>
1		Orange or Yellow 6600 Input Card Core Memory = 77K C.P. = 300 seconds P.P. = 500 seconds Plot = ✓ Tape 2 = Tape # of peak data Tape 39 = CRTPLTS or PENPLOTS
2		GREY PLOT CARD
3		DEL01, T300, CM77000, TP2. 7276 Delaney
4		FTN.
5		SETCORE.
6		ATTACH, CRT, NEWCRT, CY=3, MR=1. OR, ATTACH, PEN, PENPLOTS, MR=1.
7		REQUEST, TAPE2, HY. (PEAK TAPE #/NORING)
8		REQUEST, TAPE39, HY. (CRTPLTS/DELANEY) OR, REQUEST, TAPE39, HY. (PENPLOTS/DELANEY)
9		LOAD, CRT. OR, LOAD, PEN.
10		LGO.

<u>Card</u>	<u>Columns</u>	<u>Description</u>
11	1	7/8/9
12		PEAK PLOT FORTRAN CARD DECK
.		.
.		.
.		.
		7/8/9
		DATA CARDS
		.
		.
		.
		7/8/9
		6/7/8/9

<u>Data Cards</u>	<u>Columns</u>	<u>Description</u>
1	1-4	Total number of hours of data to be processed. EX: 4 Day Plot = 96 2 Day Plot = 48
	6	Plot Medium Option 1 = 35mm film 2 = paper
2	1-30	Free Formated Plot ID 1. 10 20 EX: Delaney 7276 OGO-F
3	1-7	Start Julian Day and Hour (JJJHHMM) N.B. The Julian day punched is actually one less than the desired day. EX: For January 30, 00 hours punch 029 0000
	10-16	Stop Julian day and hour N.B. The Julian day punched is actually one less than the desired day.
4		The 200 predefined wavelength cards as described in section 5.1.
203		5.1.
204	1	7/8/9
205	1	6/7/8/9

5.6

Statistical Summary Program (SATAV)

The function of program SATAV is to summarize and to statistically analyze the peak amplitude after background subtraction and relative intensity data. For each predefined wavelength, this analysis is performed for each requested Julian day. Within each day, analyses are performed on each three hour segment, each six hour segment, each twelve hour segment and the entire twenty-four hour period. For each time segment, the number of samples, peak amplitude mean and the unbiased estimate of standard deviation are calculated. For each time segment, the same quantities are calculated for the non-zero (long scan data only) relative intensity ratios. Any non-zero relative intensities within the time segment which are not within $(1.1) \times (\text{unbiased standard deviation})$ are eliminated, and the mean relative intensity and unbiased estimate of standard deviation are recalculated from the remaining relative intensities.

The output consists of a listing and a magnetic tape file. For each day processed, the following is printed for each of the 169 predefined wavelengths. The sensor, wavelength in angstroms and the date of data acquisition are printed followed by the time (hour and hundredths of hour as an integer number), peak intensity, background and relative intensity ratio for all peaks in the entire twenty-four hour period for the predefined wavelength. For each of the eight three-hour segments, for each of the four six-hour segments, for each of the two twelve-hour segments and for the entire twenty-four hour period, the following are printed; the beginning and end hour of the time segment, the number of peak amplitude samples in the time segment, the mean peak amplitude (I_{AV}), the unbiased standard deviation (σ_I), $I_{AV} + \sigma_I$, $I_{AV} - \sigma_I$, the number of non-zero relative intensity ratios after elimination, the mean relative intensity ratio after elimination and the unbiased estimate of standard deviation after elimination. These same quantities for each time segment are written on the magnetic tape file, one record per Julian day for each of the 169 predefined wavelengths. Figure 5.8 is an example of the SATAV printout.

Following is the deck setup for program SATAV.

<u>Card</u>	<u>Description</u>
1	Orange or Yellow 6600 input card. Core Memory = 120K C.P. = 30 seconds for each day to be processed. P.P. = 100 seconds for each day to be processed. Tape 1 = Tape # of peak data Tape 2 = Tape # of summary output
2	DEL01, T30*, CM120000, TP2. 7276 Delaney

<u>Card</u>	<u>Description</u>
3	FTN.
4	REQUEST, TAPE1, HY. (PEAK TAPE #/NORING)
5	REQUEST, TAPE2, HY. SUMMARY TAPE #/RINGIN)
6	SETCORE.
7	LGO.
8	EOR CARD (7/8/9 in Column 1)
9	SATAV FORTRAN CARD DECK
.	.
.	.
.	.
	EOR CARD
	DATA CARDS (explained below)
	EOR CARD
	EOF CARD (6/7/8/9 in Column 1)

* Add 30 for each additional day processed.

<u>Data Cards</u>	<u>Columns</u>	<u>Description</u>
1	1-7	First day to be processed in Julian day, hour and hundredths of hour as an integer number. Format is: JJJHH.HH (Decimal point assumed)
	9-15	Last day to be processed in Julian day, hour and hundredths of hour as an integer number.
2	2-5	Always = 3600
	7-10	Always = 2160
	12-15	Always = 1800
	17-20	Always = 1500
	22-25	Always = 1200
3	10-13	Predefined wavelengths in angstroms.
:	:	Same format as described in Section 5.1.
202	10-13	

The function of program SUMPLOT is to plot the 12 or 24 hour peak intensity averages versus time for each predefined wavelength over a data card defined time period. The plot frame format is similar to that described for the peak Plot Program in section 5.5. Five sets of axes, one for each of five predefined wavelengths, are stacked vertically on one plot frame. Format differences include abscissa scaling which is ten days/inch for SUMPLOT and the addition of error bar lines for each sample plotted. The error bars are the average peak intensity plus or minus the unbiased standard deviation for the samples in the 12 or 24 hour time segment. The ordinate scaling for each of the 169 predefined wavelengths is defined via data cards.

This program was designed primarily to aid in the analysis of the statistically summarized data from the entire six month data base. Consequently, the abscissa scaling is a constant 10 days/inch. The length of a plot frame is solely determined by the total number of days being plotted. For computer turnaround purposes, the program only plots summary data for one sensor during one execution. Consequently, five runs are necessary to obtain plots for all 169 predefined wavelengths for a desired time period. Figure 5.9 is an example of a frame of plotted summary data. The scaling of this example was modified for publication purposes.

The input data to program SUMPLOT is generated by program SATAV. Program SATAV created nine magnetic tapes for the entire data base. Since an execution of program SUMPLOT usually utilizes the entire span of acquisition, an intermediate step was taken to merge the nine tapes from SATAV onto two magnetic tapes. Consequently, program SUMPLOT has been designed to read both tapes.

The deck setup for program SUMPLOT follows.

<u>Card</u>	<u>Description</u>
1	Orange or Yellow 6600 Input Card.
	Core memory = 77K
	C.P. = 500 seconds
	P.P. = 1000 seconds
	Tape 1 = Tape # of chronologically first summary tape.
	Tape 2 = Tape # of chronologically second summary tape.
	Tape 39 = PENPLT or CRTPLT
	Plot = Check box on request card if plot is required.

<u>Card</u>	<u>Description</u>
2	GREY PLOT CARD.
3	DELO1, CM77000, T500, TP2. 7276 DELANEY
4	FTN.
5	REQUEST, TAPE1, HY. (1st TAPE/NORING)
6	REQUEST, TAPE2, HY. (2nd TAPE/NORING)
7	SETCORE.
8	ATTACH, PEN, NEW ON LINE PEN. OR, ATTACH, CRT, NEW ON LINE CRT.
9	LOAD, PEN. OR, LOAD, CRT.
10	LGO.
11	EOR CARD (7/8/9 in Column 1)
12	SUMPLOT FORTRAN CARD DECK
.	.
.	.
.	.
	EOR CARD
	DATA CARDS (DESCRIBED BELOW)
	.
	.
	.
	EOR CARD
	EOF CARD (6/7/8/9 in Column 1)

<u>Data Cards</u>	<u>Columns</u>	<u>Description</u>
1	1-30	30 Character Plot Identifier EX: Delaney 7276 OGO-F
2	1-3	Start Julian day of year
	8-10	Stop Julian day of year
	16	1 = Paper Plot 2 = 35mm Film Plot
	18-21	Sensor to be processed. Must be one of the following; 1200, 1500, 1800, 2160 or 3600.
3	9-12	First predefined wavelength for selected sensor
	16-20	Maximum value for ordinate scaling for first wavelength
.		.
.		.
.		.
42	9-12	*40th predefined wavelength for selected sensor
	16-20	Maximum value for ordinate scaling for 40th wavelength

<u>Data Cards</u>	<u>Columns</u>	<u>Description</u>
43	1	EOR
44	1	EOF

*If fewer than 40 predefined wavelengths for selected sensor,
blank cards must be added at end to bring total to 40.

FILE IDENTIFICATION DATA

TAPE NO. 000F 140

FILE NO. 10

EXPERIMENT NO. = 9

SATELLITE ID = 69511

DATE - JUN 9, 1969 (6/9/69)

START TIME= 6HRS. 36MINS. 52SECS. (23812 SECONDS OF DAY 160)

STOP TIME= 7HRS. 35MINS. 51SECS. (27351 SECONDS OF DAY 160)

ORBIT NO. = 53

STATION NO. = 21

PLOTTING FROM 0>0>0.00 (0.00 SECS.) TO 24>0>0.00 (86400.00 SECS.)

Figure 5.1

LONG SCAN PLOT FRAME

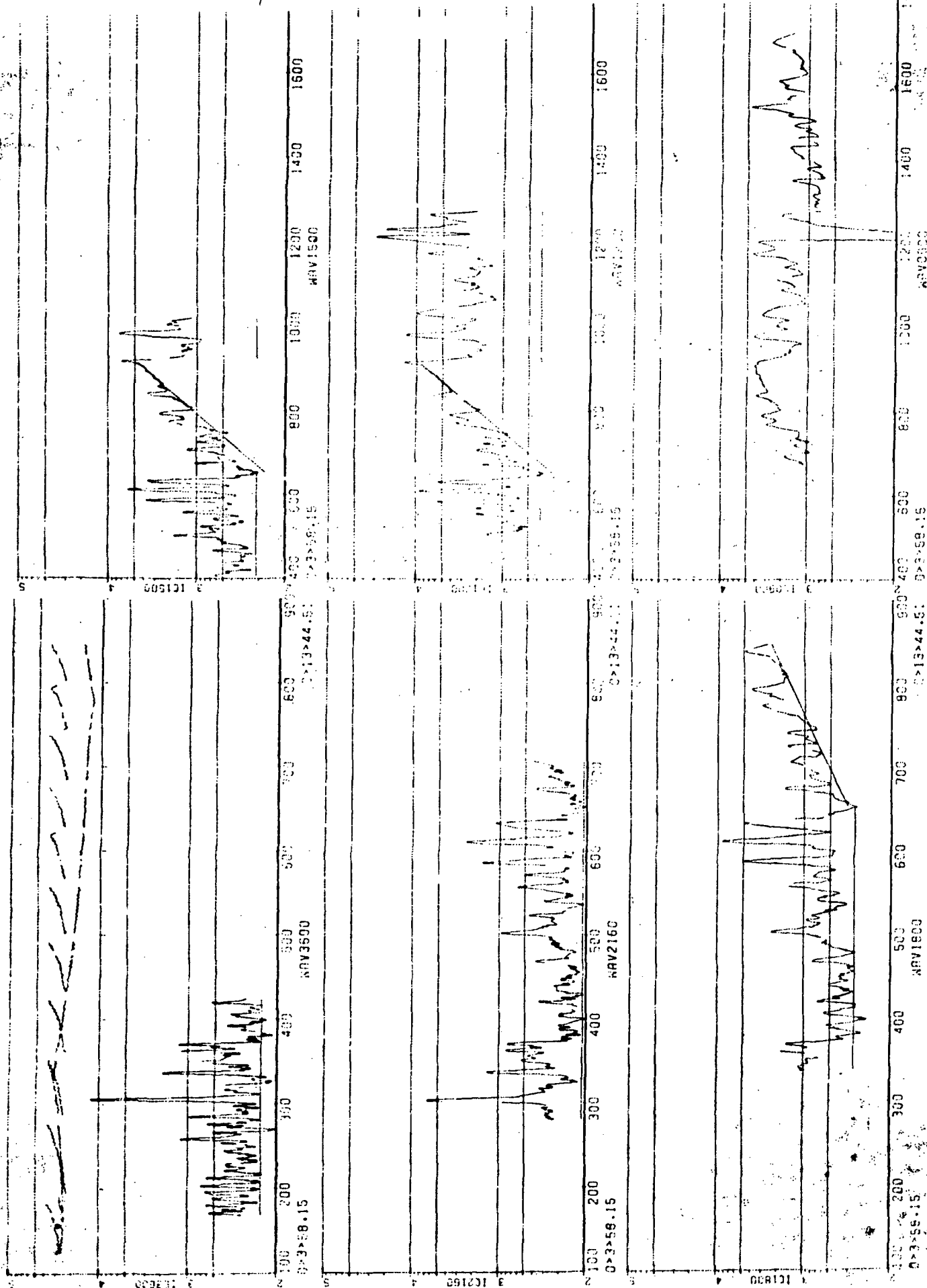


Figure 5.2

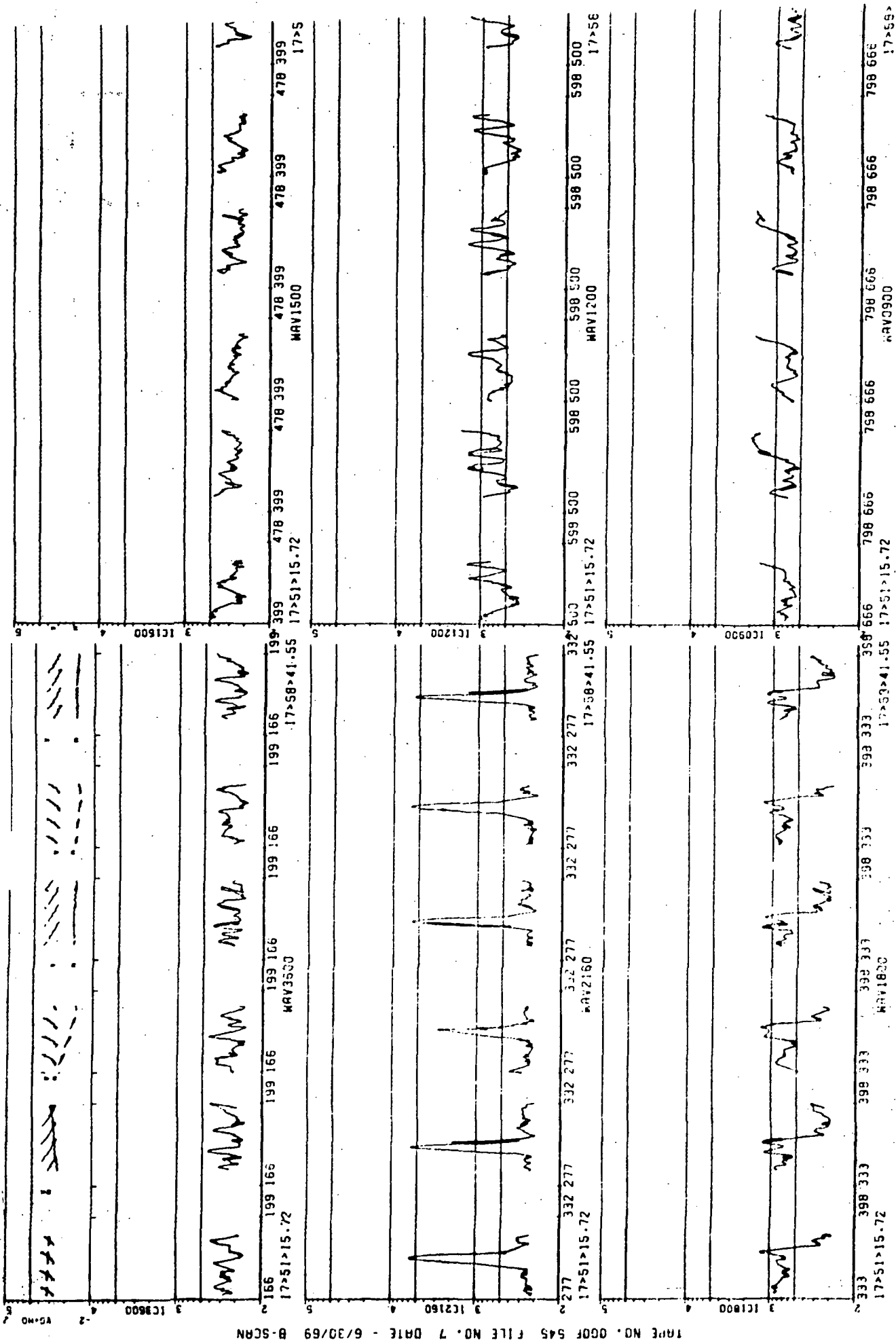


Figure 5.3

WAVELENGTH & RELATIVE INTENSITY VALUES

3600 Lines/mm		2160 Lines/mm		1800 Lines/mm	
Predefined Wavelength	Relative Intensity	Predefined Wavelength	Relative Intensity	Predefined Wavelength	Relative Intensity
175	.02456	302	1.00000	348	.06231
177	.02480	314	.03592	353	.06362
180	.03810	320	.03208	361	.16710
185	.01540	335	.19720	368	.12940
188	.03305	348	.06247	377	.01218
193	.03603	361	.12790	391	.02288
195	.04110	368	.10340	403	.02591
202	.03826	377	.01311	417	.04025
211	.03566	391	.01928	423	.01378
219	.02014	403	.02170	430	.01220
227	.02055	417	.03396	436	.02915
234	.01304	423	.01224	464	.06363
243	.02289	430	.01486	500	.21030
252	.02283	436	.02447	512	.07116
256	.08187	447	.01575	521	.09601
265	.03127	464	.04621	529	.02553
270	.01716	500	.12120	537	.05078
274	.03521	512	.03132	554	.15930
277	.01321	521	.05426	568	.16880
284	.18950	529	.01122	586	.53220
291	.01363	537	.02830	608	1.00000
295	.01449	554	.07581	630	.46950
304	1.00000	568	.06664	640	.02524
314	.02004	584	.24110	672	.19260
320	.02102	600	.02591	686	.05761
335	.17320	608	.34870	695	.06388
342	.01837	630	.19630	705	.12780
348	.04670	672	.05073	722	.12920
353	.03670	688	.07939	737	.10420
361	.11040	710	.04443	770	.18400
368	.10020			790	.18970
377	.00930			825	.03135
381	.00185			838	.21900
391	.01591				
397	.00175				
403	.01502				
409	.00544				
414	.00369				
419	.02916				
427	.01086				

Figure 5.4

WAVELENGTH & RELATIVE INTENSITY VALUES

(cont'd)

1500 Lines/mm		1200 Lines/mm	
Predefined Wavelength	Relative Intensity	Predefined Wavelength	Relative Intensity
417	.05270	537	.05983
430	.01624	554	.18360
436	.03860	568	.16270
445	.01941	584	.63040
464	.07514	608	1.00000
500	.24120	630	.56240
512	.07874	640	.02468
521	.11540	672	.17630
529	.02274	686	.07154
537	.06133	705	.15500
554	.18400	722	.13360
568	.16780	737	.10040
584	.59990	770	.23450
608	1.00000	790	.25080
630	.55020	834	.28700
640	.02545	853	.16360
672	.17040	875	.03814
686	.06943	912	.73140
705	.15070	932	.26800
722	.12480	951	.20310
737	.09886	977	1.22680
770	.23130	998	.37840
790	.25800	1005	.40700
834	.29880	1011	.41540
853	.15550	1026	.95780
875	.04533	1057	.17680
912	.73320	1081	.34040
932	.24000	1097	.18940
951	.20620	1108	.36550
977	1.21680	1138	.33980
992	.23110	1170	.81180
1002	.33160	1254	.38400
1011	.35340	1266	.66310

RDLP AND PKGROUP DECK SETUP

<u>Card #</u>	<u>Contents</u>
1	ORANGE OR YELLOW 6600 INPUT CARD
2	GRAY PLOT CARD
3	DELO1, CM165000, T250, TP2. 7276 DELANEY
4	FTN.
5	REQUEST, TAPE 3, HI, S. (OGFXXXX/NORING)
6	REQUEST, TAPE 39, HY. (CRTPLT/RING/DELANEY)
7	SETCORE.
8	I ATTACH, CRT, CRTPLOTS, MR=1.
9	LOAD, CRT.
10	LOAD, LGO.
11	EXECUTE.
12	FTN.
13	RFL, 130000.
14	LOAD, LGO.
15	EXECUTE.
16	7/8/9
	RDLP FORTRAN DECK
	.
	.
	II .
	.
	7/8/9
	RDLP DATA CARDS
	.
	.
	III .
	.
	7/8/9
	PKGROUP FORTRAN DECK
	IV 7/8/9
	PKGROUP DATA CARDS
	V 7/8/9
	6/7/8/9

Figure 5.5

CDC 6600 INPUT CARD AND PLOT REQUEST CARD

AFCLR COMPUTER CENTER		SYSTEM II		6600 INPUT CARD	
PROGRAMMER DELANEY	JOB ID DELO1	TEL. 2788	CLASS. PRODUCTION <input checked="" type="checkbox"/> CHECK OUT <input type="checkbox"/>	EITHER SYS <input checked="" type="checkbox"/>	
STATE INPUT DISK PACK PT = PAPER TAPE; BLANK = MAG TAPE	TAPE/DISK NAME (LABEL)		LIST EST. NO. PAGES 100	CORE MEMORY REQUIRED OCTAL 165 K	
3	DE-XXXX	NORINT	CREATE FILES	ESTIMATE TIME DECIMAL	
39		CRTPLTS	P. F. <input type="checkbox"/>	C. P. 250 SEC.	
			COMMON <input type="checkbox"/>	P. P. 1000 SEC.	
SPECIAL INSTRUCTIONS:		PROGRAM DECK RETURNED <input type="checkbox"/>	TAPES COPY <input type="checkbox"/> DUMP <input type="checkbox"/> VERIFY <input type="checkbox"/>	OUTPUT PUNCH <input checked="" type="checkbox"/> PLOT <input checked="" type="checkbox"/>	

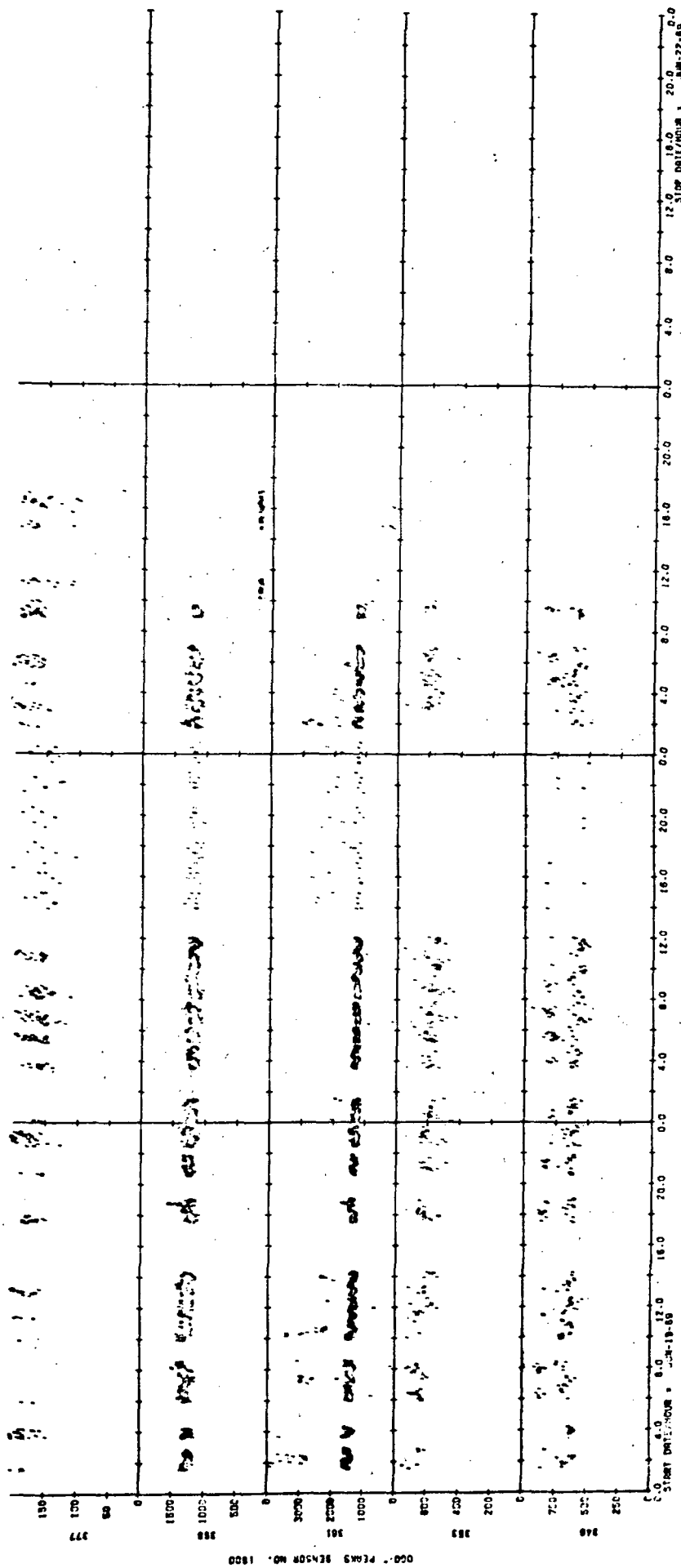
AFCLR FORM 60 (JUN 71) (REV.) 6-72

AFCLR COMPUTER CENTER			PLOT CARD		
NAME DELANEY	JOB ID DELO1	TEL. 2788	BIN NO. ACST	PROB. NO. 7276	NO. OF REC.
SPECIAL PLOT INSTRUCTIONS		BALL POINT & INK PLOT		CRT PLOT	
PAPER: 18" <input type="checkbox"/> 30" <input type="checkbox"/>		<input type="checkbox"/> (CHECK)		<input checked="" type="checkbox"/> (CHECK)	
SPECIAL: GRAPH <input type="checkbox"/>		ESTIMATED PLOT TIME _____ (MIN)		ESTIMATED NO. OF FRAMES (700 MAX) 30	
ROLL SPECS.		TAPE NO. <input type="checkbox"/>		TAPE NO. <input type="checkbox"/>	
INK: REGULAR <input type="checkbox"/> RED <input type="checkbox"/>					

AFCLR FORM JUNE-68 0-92

☐ CHECK FOR COMMENTS ON REVERSE SIDE

Figure 5.6



SENSOR 3600 WAVELENGTH 180 DATE11/14/69

TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO
876/ 247/	68/2.024	1007/ 215/	75/2.746	1039/ 323/	78/2.125	1071/ 197/	59/1.758	1366/ 246/	72/9.111
1399/ 47/	208/1.879	1531/ 37/	166/1.242	1562/ 71/	165/1.126	1731/ 134/	94/0.000	1914/ 144/	94/0.000
2221/ 146/	34/0.000								

RECOMPUTED RATIO				INTENSITY AFTER BACKGRD				RECOMPUTED RATIO			
HOURS	#PTS	MEAN	SIGMA	AV+SIG	AV-SIG	#PTS	MEAN	SIGMA	AV+SIG	AV-SIG	#PTS
0-6	0	0.0	0.000	0.0	0.0	0-6	0	0.0	0.0	0.0	0
6-12	4	243.2	57.45	300.7	185.8	6-12	4	243.2	57.45	300.7	4
12-18	5	117.0	73.81	195.8	38.2	12-18	5	117.0	73.81	195.8	5
18-24	2	145.1	1.41	146.4	143.6	18-24	2	145.1	1.41	143.6	2
0-12	4	243.2	57.45	300.7	185.8	0-12	4	243.2	57.45	300.7	4
12-24	7	125.0	65.79	190.8	59.2	12-24	7	125.0	65.79	190.8	7
0-24	11	168.0	84.54	252.5	83.5	0-24	11	168.0	84.54	252.5	11

SENSOR 3600 WAVELENGTH 180 DATE11/14/69

TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO	TIME A-INT	PKGD RATIO
874/ 209/	69/3.730	1007/ 197/	99/1.406	1040/ 321/	76/2.111	1070/ 190/	59/1.696	1366/ 205/	72/7.592
1595/ 143/	75/1.409	1637/ 133/	77/0.000	1702/ 175/	77/0.000	1714/ 166/	77/0.000	1727/ 181/	77/0.000
1739/ 153/	77/0.000	1743/ 133/	77/0.000	1760/ 140/	77/0.000	1865/ 159/	77/0.000	1922/ 151/	77/0.000
1926/ 459/	77/0.000	2182/ 122/	77/0.000	2234/ 157/	77/0.000				

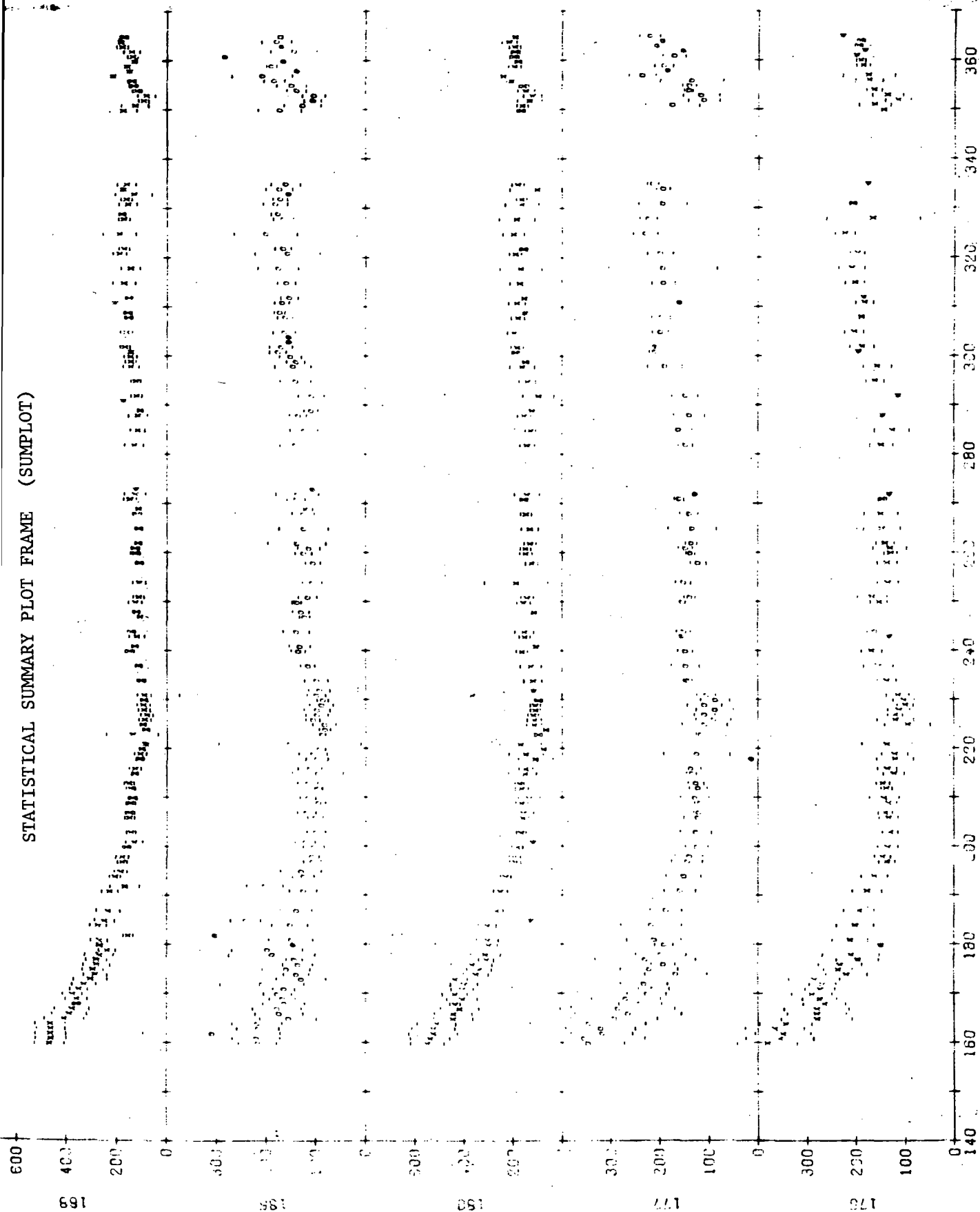
RECOMPUTED RATIO				INTENSITY AFTER BACKGRD				RECOMPUTED RATIO			
HOURS	#PTS	MEAN	SIGMA	AV+SIG	AV-SIG	#PTS	MEAN	SIGMA	AV+SIG	AV-SIG	#PTS
0-6	0	0.0	0.000	0.0	0.0	0-6	0	0.0	0.0	0.0	0
6-12	4	215.0	76.42	291.4	138.6	6-12	4	215.0	76.42	291.4	4
12-18	9	167.8	19.77	187.5	148.0	12-18	9	167.8	19.77	187.5	9
18-24	5	153.4	7.96	167.4	151.4	18-24	5	153.4	7.96	167.4	5
0-12	4	215.0	76.42	291.4	138.6	0-12	4	215.0	76.42	291.4	4
12-24	14	164.8	16.65	181.4	148.1	12-24	14	164.8	16.65	181.4	14
0-24	18	175.9	41.28	217.2	134.7	0-24	18	175.9	41.28	217.2	18

STATISTICAL SUMMARY PROGRAM PRINTOUT (SATAV)

Figure 5.8

STATISTICAL SUMMARY PLOT FRAME (SUMPLOT)

Figure 5.9



6.0 OGO-F PRODUCTION MASTER FILE LOGGING SYSTEM

The OGO-F satellite transmitted data for almost seven months. An average of 30-35 acquisitions were digitized for each universal day. Generally, two magnetic tapes contained acquisitions for one universal day, one acquisition per physical file. These data were stored on over 500 magnetic tapes. Data for some universal days required a third magnetic tape for various reasons, and some magnetic tapes contained a few acquisitions from each of several universal days. Consequently, it was evident that information pertaining to the contents of the digitized data tapes and the types of processing accomplished with the data must be made available to the research personnel and to the production personnel. The research personnel had to know if data were available in periods of scientific interest and if the data had been processed with the RDLP, PKGROUP, or the OGO Graphics programs. The production personnel had to know the contents of each digitized tape in order to proceed in a logical manner and to be able to make intelligent estimates of the completion of processing.

Generally, within a physical tape, data was stored chronologically, universal time being the only parameter unique to each acquisition. Therefore, a chronological record of the data was created.

The following subsections explain the mechanics of the logging system from both a functional and practical viewpoint.

6.1 Sources of Data

6.1.1 OGO-F Data Tape Packing Sheet

Accompanying each magnetic data tape received from NASA was a packing sheet. The packing sheets contained such information as the NASA assigned tape number, start and stop times, recording station, recording dates, and total number of files. Pertinent information was extracted from the individual records on the packing sheets and used as a basis for the production logging system. Figure 6.1 is an example of a packing sheet.

6.1.2 OGO-F Data Parameters from Research Personnel

Research personnel supplied us with data they wanted incorporated into the Master File. The parameters included experiment power supply on/off times, scan code, scan time, flare number, flare type, flare start and stop times, and flare maximum time. Additional data supplied by research personnel consisted of start and stop times for eclipse periods,

daily 10.7 CM flux averages and daily A_p averages.

6.2 Master File Data Record

The Master file consisted of 100-word data records (see figure 6.2), one record for each data acquisition. Information extracted from the packing sheet included date of recording, start time, stop time, and file number. The tape number was identified by labeling the tape "OGOFxxxx", where xxxx was a four digit number. The tapes were labeled in order by date of acquisitions in increments of 10. Tapes received after the effort which chronologically fit between the original tapes, were labeled accordingly, having numbers ending in a 3, 5, or 7.

The parameters which the research personnel supplied were incorporated into the Master File data record according to the start time of the event. If the start time was found to be between two recording periods, the information was stored in the data record which preceded the start time of the event. For each 100 word data record, a punched card was generated for updating production information to the Master File. Figure 6.3 is the format for the punched card.

When data processing was completed and verified, for a file, a file status code, date processed, film number, and a film code were added to the punched card for that file and updated to the data record for that file in the Master File. (See Section 6.4.)

6.3 OGO-F Master File Printout

The Master File printout is a computer listing generated to aid research personnel in determining data acquisitions of interest. Pertinent information was extracted from the 100-word data record for each file which comprise the OGO-F Master File. The parameters include start and stop times of data acquisitions, tape and file numbers, daily 10.7CM flux averages, daily A_p averages, power supply on/off times, scan code, time of scan change, flare event times, flare event types, and eclipse periods. Figures 6.4 and 6.4.1 are examples of the OGO-F Master File printout. Figure 6.5 is an explanation of each field on the Master File printout for 1969.

6.4 Updating Production Master File

The production master file was updated periodically for the purpose of keeping accurate account of files processed with the RDLP and PKGROUP programs.

Verification of production files consisted of reviewing the RDLP output listing, reviewing the output listing and punched card peak data from PKGROUP, and reviewing CRT film for both quality and correctness. When this task was completed, a file status, date processed, film number, if applicable, and film code, if applicable, were added to the punched card (see section 6.2) corresponding to that acquisition on the Master File.

A number of data files could not be processed for various reasons. A numerical code (see Figure 6.7) was added to the file status field of the punched card which corresponded to these acquisitions on the Master File. Figure 6.6 is an example of the punched card format used for updating this function to the OGO-F Master File.

The punched cards accumulated for one update period were sorted chronologically. For these acquisitions, the file status, date processed, film number, and film code (CRT/PEN) were added into the appropriate 100-word record. Figures 6.8 and 6.8.1 are examples of the OGO-F production log status. Figure 6.9 is an explanation of each field on the production log printout.

6.5 OGO-F Chronological Printout - 15-Minute Intervals

The computer listing consisted of data parameters extracted from the 100-word record. Each day was printed in two 12-hour segments. Each 12-hour segment is divided into 48 15-minute periods. Each 15-minute period was represented by one line of printout. Basically, any of the data, parameters, or times which occur, begin, or continue during any part of the 15-minute period are printed in a designated field for that particular line of printout for the 15-minute period. Change of power supply status or scan type is noted. Figure 6.10 is an example for the chronological printout in 15-minute intervals.

OGO-F DATA TAPE PACKING SHEET

STA	TAPE	FILE	RECORDED			EDIT		R	FF	START		STOP		OGO EXPERIMENTER		EXP
			YR	MO	DY	TAPE	FILE			HR	MN	HR	MN	DECOM	RUN	
SKA	389	1	69	7	18	1781	1	3	0	0	2	0	27	691991	1	1
SKA	389	1	69	7	18	1781	1	3	0	0	27	0	29	691991	1	2
SKA	389	1	69	7	18	1781	1	3	0	0	57	0	60	691991	1	3
ACT	254	1	69	7	18	1784	1	3	0	1	1	2	9	691991	1	4
ACT	254	1	69	7	18	1784	1	3	0	2	10	2	14	691991	1	5
ACT	256	1	69	7	18	1786	1	3	0	2	15	3	8	691991	1	6
ACT	256	1	69	7	18	1786	1	3	0	3	50	3	57	691991	1	7
ROS	233	1	69	7	18	1788	1	3	0	3	57	5	31	691991	1	8
ROS	233	1	69	7	18	1789	1	3	0	5	33	5	50	691991	1	9
ROS	233	1	69	7	18	1788	1	3	0	5	54	6	22	691991	1	10
ROS	233	1	69	7	18	1788	1	3	0	5	54	6	22	691991	1	11
SKA	393	1	69	7	18	1792	1	3	0	6	23	7	47	691991	1	12
SKA	395	1	69	7	18	1794	1	3	0	7	54	9	27	691991	1	13
SKA	397	1	69	7	18	1797	1	3	0	9	33	11	5	691991	1	14
SKA	397	1	69	7	18	1797	1	3	0	11	8	11	14	691991	1	15
SKA	397	1	69	7	18	1797	1	3	0	11	8	11	14	691991	1	16
SKA	399	1	69	7	18	1800	1	3	0	11	14	12	47	691991	1	17
SKA	399	1	69	7	18	1800	1	3	0	12	48	12	53	691991	2	1
ACT	258	1	69	7	18	1802	1	3	0	12	54	14	28	691991	2	2
ACT	258	1	69	7	18	1802	1	3	0	14	35	15	1	691991	2	3
ACT	260	1	69	7	18	1806	1	3	0	15	2	16	33	691991	2	4
ACT	260	1	69	7	18	1806	1	3	0	16	34	16	40	691991	2	5
QUI	133	1	69	7	18	1809	1	3	0	16	52	18	14	691991	2	6
ROS	234	1	69	7	18	1811	1	3	0	18	15	19	2	691991	2	7
MAD	164	1	69	7	18	1814	1	3	0	19	7	20	41	691991	2	8
MAD	164	1	69	7	18	1814	1	3	0	21	3	21	11	691991	2	9
MAD	164	1	69	7	18	1814	1	3	0	21	10	21	34	691991	2	10
MAD	166	1	69	7	18	1818	1	3	0	21	35	22	48	691991	2	11
WNK	192	1	69	7	18	1821	1	3	0	23	13	0	27	691991	2	12
WNK	192	1	69	7	19	1821	1	3	0	0	28	0	33	691991	2	13

TOTAL NO. OF FILES = 30

PLEASE ACKNOWLEDGE RECEIPT AND RETURN FORM 22-51
 DIGITAL DATA ACCOUNTING OFFICE
 DIGITAL DATA CONTROLLER
 NASA GODDARD SPACE FLIGHT CENTER
 CODE 565
 GREENBELT, MD. 20771

Figure 6.1

FORMAT OF OGO-F MASTER FILE DATA RECORD

<u>Word #</u>	<u>Type</u>	<u>Variable</u>
1	A	Satellite Name (OGO-F)
2	I	Date (YYMMDD)
3	I	Start Time (HHMM)
4	I	Stop Time (HHMM)
5	I	Minutes of Coverage
6		Not Used
7		Not Used
8	I	Pass Number
9	I	Input Tape Number
10		Not Used
11	I	Input File Number
12		Not Used
13		Not Used
14		Not Used
15	I	Date
16	I	User
17	A	Version
18	I	Date
19	I	User
20	A	Version
21	I	Date
22	I	User
23	A	Version
24	I	Date
25	I	User
26	A	Version
27	I	Date
28	I	User
29	A	Version
30	A	Film Code (CRT/PEN)
31	I	File Status
32	I	Film Number
33		Not Used
34	I	10.7 CM Flux Averages
35	I	A Averages
36	I	HV Pwr Sup #1 1=Off 2=On
37	I	Pwr Sup #1 Time Off/Time On
38	I	HV Pwr Sup #2 1=Off 2=On
39	I	Pwr Sup #2 Time Off/Time On
40	A	Scan Code
41	I	Scan Time
42		Not Used

Figure 6.2

<u>Word #</u>	<u>Type</u>	<u>Variable</u>
43	I	1st Flare Number
44	I	1st Flare Imp Code
45	A	1st Flare Type Code
46	I	1st Flare Start Time
47	I	1st Flare Stop Time
48	I	1st Flare Max. Time
49	I	2nd Flare Number
50	I	2nd Flare Imp Code
51	A	2nd Flare Type Code
52	I	2nd Flare Start Time
53	I	2nd Flare Stop Time
54	I	2nd Flare Max. Time
55	I	3rd Flare Number
56	I	3rd Flare Imp Code
57	A	3rd Flare Type Code
58	I	3rd Flare Start Time
59	I	3rd Flare Stop Time
60	I	3rd Flare Max. Time
61	I	Start Time Eclipse #1
62	I	Duration Eclipse #1
63	I	Start Time Eclipse #2
64	I	Duration Eclipse #2
65	I	Start Time Eclipse #3
66	I	Duration Eclipse #3

WORDS 67-100 ARE NOT USED

Figure 6.2

FORMAT OF PUNCHED CARD GENERATED FROM MASTER FILE DATA RECORD

<u>Columns</u>	<u>Code</u>	<u>Description</u>
1-4	A4	Satellite Name
6-11	I6	Date (YYMMDD)
13-16	I4	Start Time (HHMM)
18-21	I4	Stop Time (HHMM)
26-30	I5	Input Tape Number
32-33	I2	Input File Number
76-77	I2	User Code
79-80	I2	Function Code (1)

Figure 6.3

Figure 6.4

***** GGO MASTER FILE *****

DATE YYMMDD	START TIME	STOP TIME	MIN COV	TAPE NCS.	FILE NOS.	10CM FLUX	A (P)	HV 01 TIME	HV 02 TIME	SCAN CODE	TIME	FLARE NUMBER	FLR TYP	FLR STRT	FLAR STOP	FLAR MAX	ECLP1 START	DURA TION	ECLP2 START	DURA TION
690808	1910	2007	57	1420	11	1503	9	2	0	S11	1912	0	0	0	0	0	1802	35	0	0
690808	2011	2145	94	1420	12	1503	9	2	0	S11	1912	0	0	0	0	0	2032	34	0	0
690808	2146	2151	5	1420	13	1503	9	2	0	S11	1912	0	0	0	0	0	0	0	0	0
690808	2152	2325	94	1430	1	1503	9	2	0	S11	1912	0	0	0	0	0	2211	34	0	0
690808	2327	2333	6	1430	2	1503	9	2	0	S11	1912	0	0	0	0	0	0	0	0	0
690808	2333	107	94	1430	3	1503	9	2	0	S11	1912	0	0	0	0	0	2351	34	0	0
690809	109	110	7	1440	1	1455	11	1	109	0	109	0	0	0	0	0	0	0	0	0
690809	116	250	94	1440	2	1455	11	1	0	LNG	1912	0	0	0	0	0	130	35	0	0
690809	252	259	7	1440	3	1455	11	1	0	LNG	1912	0	0	0	0	0	0	0	0	0
690809	259	433	94	1440	4	1455	11	1	0	LNG	1912	0	0	0	0	0	310	34	0	0
690809	434	442	8	1440	5	1455	11	1	0	LNG	1912	0	0	0	0	0	0	0	0	0
690809	442	616	94	1440	6	1455	11	1	0	S06	615	2-710 IF	519	519	524	450	34	0	0	0
690809	617	623	6	1440	7	1455	11	1	0	S06	615	2-710 IF	519	519	524	0	0	0	0	0
690809	623	757	94	1440	8	1455	11	1	0	S06	615	2-710 IF	519	519	524	629	34	0	0	0
690809	758	803	5	1440	9	1455	11	1	0	S06	615	2-710 IF	519	519	524	0	0	0	0	0
690809	804	937	93	1440	10	1455	11	1	0	S06	615	2-710 IF	519	519	524	809	34	0	0	0
690809	938	943	5	1440	11	1455	11	1	0	S06	615	2-710 IF	519	519	524	0	0	0	0	0
690809	944	1118	94	1440	12	1455	11	1	0	S06	615	2-710 IF	519	519	524	949	34	0	0	0
690809	1125	1151	26	1440	13	1455	11	1	0	S06	615	2-710 IF	519	519	524	1128	34	0	0	0
690809	1155	1326	31	1450	1	1455	11	1	0	S06	615	2-710 IF	519	519	524	1128	34	1308	34	0
690809	1326	1332	6	1450	2	1455	11	1	0	S06	615	2-710 IF	519	519	524	0	0	0	0	0
690809	1332	1506	94	1450	3	1455	11	1	0	S06	615	2-710 IF	519	519	524	1308	34	1448	34	0
690809	1508	1546	38	1450	4	1455	11	1	0	S06	615	2-710 IF	519	519	524	1448	34	0	0	0
690809	1549	1602	13	1450	5	1455	11	1	0	S10	1550	0	0	0	0	0	1627	34	0	0
690809	1602	1652	50	1450	6	1455	11	1	0	S10	1550	0	0	0	0	0	1807	34	0	0
690809	1652	1701	9	1450	7	1455	11	1	0	S10	1550	0	0	0	0	0	0	0	0	0
690809	1739	1913	94	1450	8	1455	11	1	0	S10	1550	0	0	0	0	0	1947	33	0	0
690809	1915	1933	18	1450	9	1455	11	1	0	S10	1550	0	0	0	0	0	1947	33	0	0
690809	1934	2005	31	1450	10	1455	11	1	0	S10	1550	0	0	0	0	0	2126	34	0	0
690809	2006	2140	94	1450	11	1455	11	1	0	S10	1550	0	0	0	0	0	2126	34	0	0
690809	2141	2215	34	1450	12	1455	11	1	0	S10	1550	0	0	0	0	0	0	0	0	0
690809	2215	2247	32	1450	13	1455	11	1	0	S09	2240	0	0	0	0	0	2306	34	0	0
690809	2248	21	93	1450	14	1455	11	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	23	28	5	1460	1	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	29	203	94	1460	2	1393	6	1	0	S09	2240	0	0	0	0	0	46	33	0	0
690810	204	212	8	1460	3	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	213	347	94	1460	4	1393	6	1	0	S09	2240	0	0	0	0	0	225	34	0	0
690810	348	357	9	1460	5	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	357	531	94	1460	6	1393	6	1	0	S09	2240	0	0	0	0	0	405	34	0	0
690810	532	538	6	1460	7	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	538	710	92	1460	8	1393	6	1	0	S09	2240	0	0	0	0	0	545	33	0	0
690810	712	718	6	1460	9	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	718	852	94	1460	10	1393	6	1	0	S09	2240	0	0	0	0	0	724	34	0	0
690810	853	658	5	1460	11	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	859	1031	92	1460	12	1393	6	1	0	S09	2240	0	0	0	0	0	904	34	0	0
690810	1033	1039	6	1460	13	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	1033	1039	6	1463	1	1393	6	1	0	S09	2240	0	0	0	0	0	0	0	0	0
690810	1040	1214	34	1463	2	1393	6	1	0	S09	2240	0	0	0	0	0	1044	33	0	0
690810	1249	1423	94	1463	3	1393	6	1	0	S05	1242	0	0	0	0	0	1223	34	1403	33
690810	1425	1460	35	1463	4	1393	6	1	0	S05	1242	0	0	0	0	0	1403	33	0	0

Figure 6.4.1

DATE YYMMDD	START TIME	STOP TIME	MIN COV	TAPE NCS.	FILE NOS.	10CM FLUX	A (P)	HV C1	HV C2	SCAN CODE	SCAN TIME	FLARE NUMBR	FLR TYP	FLR SRT	FLR STOP	FLR MAX	ECLP1 START	DURA TION	ECLP2 START	DURA TION
690810	1503	1512	9	1315	12	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1512	1516	7	1315	13	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1516	1649	93	1315	14	1393	6	1	2	S05	0	0	0	0	0	0	1242	34	0	0
690810	1651	1656	5	1463	5	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1651	1656	5	1315	15	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1656	1831	35	1315	16	1393	6	1	2	S05	0	0	0	0	0	0	1722	34	0	0
690810	1832	1849	17	1315	17	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1849	1857	8	1463	6	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1849	1857	8	1315	18	1393	6	1	2	S05	0	0	0	0	0	0	0	0	0	0
690810	1856	1920	24	1463	7	1393	6	1	2	S05	0	0	0	0	0	0	1902	33	0	0
690810	1920	2052	32	1465	1	1393	6	1	2	S02	2015	0	0	0	0	0	1902	33	2041	34
690810	2050	2129	33	1463	8	1393	6	1	2	S02	0	0	0	0	0	0	2041	34	0	0
690810	2130	2201	31	1463	9	1393	6	1	2	S02	0	0	0	0	0	0	0	0	0	0
690810	2202	2336	94	1465	2	1393	6	1	2	S02	0	0	0	0	0	0	2221	34	0	0
690810	2337	2343	6	1465	3	1393	6	1	2	S02	0	0	0	0	0	0	0	0	0	0
690810	2344	2343	6	1467	1	1393	6	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	119	120	7	1465	4	1393	6	1	2	S02	0	0	0	0	0	0	1	33	0	0
690811	119	120	7	1470	1	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	126	234	88	1470	2	1359	4	1	2	S02	0	0	0	0	0	0	140	34	0	0
690811	301	309	8	1470	3	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	309	443	34	1470	4	1359	4	1	2	S02	0	0	0	0	0	0	32	33	0	0
690811	445	452	7	1470	5	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	453	620	93	1470	6	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	627	632	5	1470	7	1359	4	1	2	S02	0	0	0	0	0	0	500	33	0	0
690811	632	800	34	1470	8	1359	4	1	2	S02	0	0	0	0	0	0	639	34	0	0
690811	808	815	7	1470	9	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	816	948	92	1470	10	1359	4	1	2	S02	0	0	0	0	0	0	819	33	0	0
690811	948	954	6	1470	11	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	954	1127	93	1470	12	1359	4	1	2	S02	0	0	0	0	0	0	959	33	0	0
690811	1132	1204	32	1470	13	1359	4	1	2	S02	0	0	0	0	0	0	1138	34	0	0
690811	1204	1336	92	1480	1	1359	4	2	0	S02	0	24775	18	1212	1243	1223	1138	34	1318	33
690811	1337	1343	6	1480	2	1359	4	2	0	S02	0	0	0	0	0	0	0	0	0	0
690811	1343	1517	94	1480	3	1359	4	2	0	S02	0	0	0	0	0	0	1318	33	1458	33
690811	1519	1556	37	1480	4	1359	4	2	0	S02	0	0	0	0	0	0	1458	33	0	0
690811	1559	1611	12	1480	5	1359	4	2	0	S02	0	0	0	0	0	0	1637	34	0	0
690811	1612	1746	34	1480	6	1359	4	1	2	S02	0	24704	1N	1643	1719	1050	0	0	0	0
690811	1747	1805	18	1480	7	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	1807	1836	29	1480	8	1359	4	1	2	S02	0	0	0	0	0	0	1817	33	0	0
690811	1828	2102	94	1480	9	1359	4	1	2	S02	0	0	0	0	0	0	1957	32	0	0
690811	2103	2117	14	1480	10	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	2117	2249	92	1480	11	1359	4	1	2	S02	0	0	0	0	0	0	2130	33	0	0
690811	2251	2250	5	1480	12	1359	4	1	2	S02	0	0	0	0	0	0	0	0	0	0
690811	2257	31	94	1480	13	1359	4	1	2	S02	0	0	0	0	0	0	2316	33	0	0
690812	32	41	9	1490	1	1286	21	1	0	S15	0	24794	1N	152	441	+07	55	34	0	0
690812	41	214	93	1490	2	1286	21	1	0	S15	0	0	0	0	0	0	0	0	0	0
690812	217	222	5	1465	6	1286	21	1	0	S15	0	0	0	0	0	0	0	0	0	0
690812	221	249	28	1490	3	1286	21	1	0	S15	0	0	0	0	0	0	235	33	0	0
690812	250	424	34	1490	4	1286	21	1	0	S15	0	0	0	0	0	0	235	33	415	33
690812	425	515	50	1490	5	1286	21	1	0	S15	0	0	0	0	0	0	415	33	0	0

FORMAT & DESCRIPTION OF MASTER FILE PRINTOUT

<u>Print Positions</u>	<u>Description</u>
2-7	Date of Acquisition (YYMMDD)
10-13	Start Time of Acquisition (HHMM)
17-20	Stop Time of Acquisition (HHMM)
23-25	Minutes of Coverage (MMM)
28-31	Input Tape Number
34-35	Input File Number
39-42	Daily 10.7 CM Flux Average
45-46	Daily A _p Averages
49	HV PWR Sup #1 1=Off, 2=On
52-55	PWR Sup #1 Time Off/Time On
58	HV PWR Sup #2 1=Off, 2=On
61-64	PWR Sup #2 Time Off/Time On
67-69	Scan Code
72-75	Scan Time
78-82	1st Flare Number
84	1st Flare Imp Code
85	1st Flare Type Code
88-91	1st Flare Start Time
93-96	1st Flare Stop Time
98-101	1st Flare Max. Time
105-108	Start Time Eclipse #1
112-113	Duration (MM) Eclipse #1
118-121	Start Time Eclipse #2
125-126	Duration (MM) Eclipse #2

Figure 6.5

PUNCHED CARD FORMAT TO UPDATE PRODUCTION MASTER FILE

<u>Columns</u>	<u>Code</u>	<u>Description</u>
1-4	A4	Satellite Name
6-11	I6	Date (YYMMDD)
13-16	I4	Start Time (HHMM)
18-21	I4	Stop Time (HHMM)
26-30	I5	Tape Number Processed
32-33	I2	File Number Processed
38	I1	Plot Code {0=No Plot 1=CRT Plot 2=PEN Plot
40-41	I2	File Status (see Figure 6.7)
45-46	I2	Film Number (CRT only)
76-77	I2	User Code
79-80	I2	Function Code (1)

Figure 6.6

FILE STATUS - NUMERICAL CODE DEFINITIONS

0	=	ACCEPTABLE FILE
1	=	INSUFFICIENT DATA IN FILE (HEADER ONLY)
2	=	DAMAGED DATA TAPE
3	=	POWER SUPPLIES OFF
4	=	FILE CONTAINS LONG AND SHORT SCAN DATA
5	=	MISSING DATA TAPE
6	=	DISCREPANCY BETWEEN START AND STOP TIMES
7	=	BAD DATA IN FILE
8	=	FOUR (4) MESSAGES PER SCAN POSITION

Figure 6.7

*** 060-F UPDATE AS OF 730210 ***

DATE YYMMDD	START TIME	STOP TIME	MIN COV	TAPE NOS.	FILE NOS.	ACCEPT DATE	CRT/ PEN	FILE STAT	FILM NUM.
090627	743	041	58	500	8	0		0	0
090627	840	1013	87	550	9	730115		2	0
090627	1014	1019	5	560	10	0		0	0
090627	1020	1143	83	560	11	730115		2	0
090627	1144	1149	5	560	12	0		0	0
090627	1143	1323	94	560	13	720121	CRT	0	3
090627	1324	1330	0	560	14	0		0	0
090627	1330	1425	55	570	1	730115	CRT	0	16
090627	1429	1450	21	570	2	0		0	0
090627	1458	1511	13	570	3	0		0	0
090627	1512	1553	30	570	4	730115	CRT	0	16
090627	1554	1603	9	580	1	0		0	0
090627	1604	1619	15	580	2	0		0	0
090627	1619	1633	14	580	3	0		0	0
090627	1633	1807	94	580	4	730115	CRT	0	16
090627	1809	1823	14	580	5	0		0	0
090627	1823	1830	7	580	6	0		0	0
090627	1830	1855	25	580	7	0		0	0
090627	1855	2000	71	580	8	730115	CRT	0	16
090627	2008	2029	21	580	9	730115	CRT	0	16
090627	2303	2329	20	455	16	0		0	0
090628	45	109	24	590	1	730115	CRT	0	16
090628	110	120	10	590	2	0		0	0
090628	135	247	72	545	3	0		0	0
090628	253	409	76	590	3	730115	CRT	0	16
090628	409	414	5	590	4	0		0	0
090628	414	524	70	590	5	730115		1	0
090628	523	701	92	590	6	730210	CRT	0	43
090628	701	706	5	545	4	0		0	0
090628	717	807	50	590	7	730115	CRT	0	26
090628	811	928	77	590	8	720121	CRT	0	3
090628	929	934	5	590	9	0		0	0
090628	934	1108	94	590	10	0		0	0
090628	1109	1136	27	590	11	0		0	0
090628	1139	1207	28	590	12	0		0	0
090628	1208	1240	32	590	13	0		0	0
090628	1240	1417	91	590	14	0		0	0
090628	1419	1426	7	590	15	0		0	0
090628	1426	1522	56	590	16	0		0	0
090628	1526	1650	94	590	17	0		0	0
090628	1701	1728	27	590	18	0		0	0
090628	1728	1903	95	600	1	0		0	0
090628	1904	1949	45	600	2	0		0	0
090628	1950	2021	31	600	3	0		0	0
090628	2022	2156	94	600	4	0		0	0
090628	2158	2213	15	600	5	0		0	0
090628	2213	2223	10	545	5	0		0	0
090628	2223	2357	94	600	6	730115	CRT	0	17
090628	2359	4	5	600	7	0		0	0
090629	15	47	32	455	17	0		0	0

Figure 6.8

DATE YYMMDD	START TIME	STOP TIME	MIN COV	TAPE NOS.	FILE NOS.	ACCEPT DATE	CRT/ PEN	FILE STAT	FILM NUM.
690629	47	219	92	610	1	730115	CRT	0	17
690629	220	226	6	610	2	0		0	0
690629	226	325	99	610	3	730115	CRT	0	17
690629	329	434	65	610	4	730115	CRT	0	17
690629	434	614	95	610	5	730115	CRT	0	17
690629	615	622	7	610	6	0		0	0
690629	623	757	94	610	7	730115	CRT	0	17
690629	758	818	20	610	8	0		0	0
690629	819	849	30	610	9	0		0	0
690629	849	1023	94	610	10	730115	CRT	0	17
690629	1027	1039	12	455	18	0		0	0
690629	1038	1132	54	610	11	730115	CRT	0	17
690629	1133	1150	27	610	12	0		0	0
690629	1201	1258	57	610	13	0		0	0
690629	1302	1335	33	620	1	730115	CRT	0	17
690629	1336	1437	59	620	2	730115	CRT	0	17
690629	1441	1615	94	620	3	730115	CRT	0	17
690629	1616	1644	28	620	4	0		0	0
690629	1644	1618	94	620	5	730115	CRT	0	17
690629	1819	1905	46	620	6	0		0	0
690629	1906	1938	32	620	7	0		0	0
690629	1939	2113	94	620	8	730115	CRT	0	17
690629	2114	2127	13	620	9	0		0	0
690629	2127	2139	12	620	10	0		0	0
690629	2139	2313	94	620	11	730115	CRT	0	17
690629	2315	5	50	620	12	0		0	0
690630	5	37	32	620	13	0		0	0
690630	143	240	57	625	1	730115	CRT	6	17
690630	244	350	66	625	2	730115	CRT	0	17
690630	350	354	4	625	3	0		0	0
690630	355	524	94	625	4	730115	CRT	6	17
690630	530	537	7	625	5	0		0	0
690630	538	712	94	625	6	730115		7	0
690630	713	749	36	625	7	0		0	0
690630	749	800	17	625	8	0		0	0
690630	807	810	9	625	9	0		0	0
690630	810	940	82	625	10	730115	CRT	0	17
690630	941	946	5	625	11	0		0	0
690630	946	1110	84	625	12	730115	CRT	0	17
690630	1111	1115	4	625	13	0		0	0
690630	1116	1250	94	625	14	730115	CRT	0	17
690630	1250	1256	6	625	15	0		0	0
*690630	1256	1353	57	625	16	730210	CRT	0	43
690630	1357	1531	94	627	1	730115		1	0
690630	1532	1540	8	545	6	0		0	0
690630	1540	1550	20	627	2	0		0	0
690630	1550	1704	64	627	3	730115	CRT	0	17
690630	1704	1734	30	627	4	730115		1	0
690630	1736	1751	15	627	5	730115	CRT	0	17
690630	1736	1751	15	627	6	0		0	0

Figure 6.8.1

FORMAT & DESCRIPTION OF PRODUCTION LOG PRINTOUT

<u>Print Positions</u>	<u>Description</u>
1	An asterisk denotes a file has been processed and verified during the last update period
2-7	Date of Acquisition
11-14	Start Time of Acquisition
19-22	Stop Time of Acquisition
26-28	Minutes of Coverage
31-35	Assigned Tape Number
40-41	File Number
47-52	Date of Acceptance
56-58	Plot Code (CRT/PEN)
64-65	File Status
70-71	Film Number

Figure 6.9

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7.0 OGO-F INTERACTIVE GRAPHICS APPLICATION PROGRAM (OGOGRAF)

Program OGOGRAF is an interactive graphics program designed to aid in the analysis of spectral data acquired from the six sensors flown on the OGO-F satellite. The batch processing program, RDLF, which performed bulk analysis of the digitized data was modified to create a data base for OGOGRAF, the graphics application program. A format was developed to include all possible data for graphics analysis. The OGO-F data on the original digitized data tapes was comprised of multiple files, one file for each acquisition. Each acquisition consisted of several scans of data. Each scan contained 512 samples for each of six sensors. Each sensor recorded data from a different spectral range.

A file of data for the graphics application data base was structured as follows. A file header record contained the original tape and file number, date of acquisition, orbit number and 20 parameters used in the batch processing program. The 20 parameters were included since they were control card inputs and could be changed in the batch processing program. These parameters were used primarily in the aspect and backlash correction routines. Each scan in the file was preceded by a scan header record which included the number of data records in the scan and whether the scan was a backward or forward scan. Each data record contained the scan position, time, wavelength, uncorrected sensor count, and aspect corrected sensor count for each of the six sensors and also the two aspect angles with the three components of each angle. This format and file structure included all parameters necessary for any stage of analysis from raw data to corrected data.

The graphics application program was designed to anticipate a multiple file data base. The first interactive task was for the researcher to enter via the alphanumeric keyboard the tape and file number of the data set to be analyzed. The character string was decoded and edited. If an illegal character was decoded, an explanatory message was displayed. If the entire data base was searched without encountering the requested file, a prompter message was displayed on the screen requesting a new file or program termination. Once the file was located, the researcher was requested to define, via the keyboard, the log scaling desired for the initial display. This scaling could be changed any time during the analysis by picking the Y-scale button and entering the new Y-maximum and minimum through the keyboard.

The data for the first scan of the file was then stored in the random access file. All data in each record were stored to facilitate the displaying of other parameters from this scan at the researcher's discretion. As the data were stored, the wavelengths and corrected sensor values for the first of the six sensors were stored in the

display arrays. As they were being stored, the minimum and maximum wavelengths were saved. These wavelengths were used to define X-minimum and X-maximum for the console display. This allowed for the most efficient utilization of the limited expanse of the visible console screen. The sensor values were converted to logs, and the logs and the wavelengths were converted to graphics display units. The display itself consisted of the axes, labeling of the axes, start and stop time of the scan, the scan direction and the 512 samples connected by line segments. Figure 7.1 is a plot of this initial display.

The primary functions of OGOGRAF were five in number. These functions were display flexibility, peak analysis, experiment background definition and application, sensor correction analysis and documentation of interactive graphics procedures and results.

Display flexibility included the ability to advance from scan to scan, to select the sensor within a scan being displayed, to choose the parameters for a particular sensor to be displayed and to modify both the X and Y scaling of the display.

The NEWSCAN primary button, when picked, automatically read the next consecutive scan, stored the data in the random access file and displayed the first of the six sensors. The SENSOR primary button, when picked, displayed a menu of the six sensors with appropriate pseudonyms. The researcher then picked the sensor to be displayed. OGOGRAF then read the random access file extracting the sensor readings and wavelengths for that sensor, converted the sensor readings to logs, converted the logs and wavelengths to display units and formed the display with appropriate labels. Thus the researcher could display the data from any of the six sensors in any order. If he decided to display the sensors in a predefined sequence, the picking of the CONTINUE primary button advanced to the next of the six sensors and displayed the data. The sensor sequence was 3600, 2160, 1800, 1500, 1200 and 900 grating lines/MM. Normally, the aspect corrected sensor values were displayed. By picking the RAW DATA primary button, the uncorrected sensor data would be extracted from the random access file. Any future requests for new sensors would display the uncorrected data for that sensor. Figure 7.2 is a plot of the uncorrected data. The COMPUTED primary button resulted in the corrected sensor data being extracted and displayed. The Y-SCALE primary button allowed the currently displayed data to be rescaled on the log axis. The minimum and maximum decade values were entered via the alphanumeric keyboard. The newly defined Y-Scaling would also apply to any new displays until Y-SCALE was picked again, and new log scaling was defined. Figure 7.3 is a plot of the data in Figure 7.1 with modified scaling. The SCISSORS primary button was used to select any segment

of the current display and to redisplay that segment over the full extent of the X-AXIS. The researcher defined the leftmost and rightmost extent of the segment by moving the tracking cross to the desired X locations. Two vertical lines were displayed at the extents. If the researcher desired that segment, he picked the ACCEPT secondary button; and the data in the display arrays within the boundaries of the segment were extracted, a new X-minimum and maximum defined; and the data were displayed over the entire X-AXIS of the display. This allowed the researcher to more clearly analyze portions of the spectrum with a high density of lines. The SCISSORS application applied only to the data currently being displayed. A request for a new sensor or a new scan would scale the entire data set for the sensor along the X-AXIS. Figure 7.4 is a plot of the first half of Figure 7.1 expanded.

By selecting the appropriate task request buttons which pertain to display manipulation, the researcher had full flexibility to display any portion of any sensor of any scan in his data set. A new file in the graphics database could be accessed by selecting the PINIT primary button which accepted the new tape and file number, located it in the data base, stored the first scan in the random access file and displayed the data from the 3600 sensor on the first scan.

The second primary function of OGOGRAF was to allow the researcher to interactively define peaks from the data currently being displayed. The VALUES primary button allowed the researcher to position the tracking cross over a data sample. The ACCEPT secondary button was picked, and the data sample closest to the center of the tracking cross was flashed. The sensor value and the wavelength of the picked point were also displayed on the screen. By selecting the NEXT secondary button the researcher could display the coordinates of as many data samples as desired. The task was completed when the END secondary button was chosen. The PEAK primary button allowed the researcher to pick data samples considered to best represent peaks for the sensor being displayed. Since most scans contained 20-30 legitimate, identifiable peaks, it was necessary to simplify this procedure as much as possible. Consequently, when PEAK was chosen, the sensor readings being displayed were interrogated. Those which fulfilled a simple possible peak criteria were made light-pen sensitive on the display. The data samples not considered to be a possible peak remained insensitive to the light-pen. Forty-fifty samples of the 512 fulfilled the peak criteria. Most importantly, the light-pen sensitive samples would be bordered by insensitive samples to greatly reduce the possibility of picking an unwanted sample as a peak. By displaying the possible peaks as light-pen sensitive points, it was only necessary for the researcher to engage the switch on the light-pen to return the identity of the sample to the processing module in the CDC 6600. The researcher knew the sample picked because it flashed. If it was not the correct sample, it would be deleted from the queue by simply again picking the flashing point on the display. In this manner, he could pick all peaks in a display in a matter of seconds, review the flashing

points, make any additions or deletions, and pick the END secondary button. When END was picked, the queue of selected peaks was transferred to the 6600. The time, wavelength and intensity of the peaks were extracted from the random access file and printed for a permanent, hard copy record of the analysis.

The third primary function of OGOGRAF was to analyze and to define background intensities to study the consistency of the background and the subtraction of the background from peak values to obtain the true peak value. Each of the six sensors had a unique background profile. Some had a constant background throughout the scan, others had segments with constant background and segments with exponentially increasing background. Two primary buttons were made available for this analysis. BKGROUND enabled the researcher to divide the scan being displayed with the tracking cross into one, two or three segments which accommodated all background combinations for the six sensors. Vertical lines were displayed at the segment interfaces. If the lines showed that the segments were not correct, they could be redefined via the tracking cross; and new vertical lines would be displayed. The type of background, constant or exponential, and the actual backgrounds were then defined for each segment. The researcher picked either the HORIZONTAL or EXPONENTIAL secondary buttons with the light-pen. For the former, he moved the tracking cross to the desired Y-Value to be used as the background for that segment. He picked ACCEPT, and a horizontal line was displayed over the range of that segment. If the background looked too high or too low, it could be redefined with the tracking cross. When ACCEPT was picked a second time, the segment boundaries in angstroms and the background level were stored in an array for that sensor. For the exponential background, the tracking cross was used to define two points in the segment. Since the display was semi-log, an exponential background line could be defined by a straight line on the log scale. The line defined by the two points was displayed over the extent of the segment. If acceptable, the segment boundaries in angstroms and the slope and Y-Intercept of the line were saved in the array for that sensor. If the background line was unacceptable, two new points could be defined with the tracking cross. Figure 7.5 shows the 1200 lines/MM sensor before background subtraction.

Once the background lines had been defined for a sensor, the researcher could subtract this background from all 512 samples in the scan by picking the SUBTRACT primary button. The wavelength for each sample would be matched with the applicable background segment. If it was a constant background segment, the background defined by the horizontal line would be subtracted. If it was an exponential background segment, the first degree equation would be solved for the wavelength yielding the log of the background. The antilogs of the sensor reading and background were calculated; the background was subtracted; and the reading minus the background would be converted to a Log_{10} value. When all 512 samples

were processed, the new scan minus the background was redisplayed. By rescaling the X-AXIS, the researcher could then analyze the results.

Once the background parameters had been established for a sensor, the data for that sensor for any other scan could be corrected for background by selecting the SUBTRACT primary button after the new sensor data had been displayed. Analysis of the consistency of the background levels was performed in this manner. However, the background parameters could be redefined at any time by selecting the BKGROUND primary button.

The fourth primary function of OGOGRAF was the sensor correction analyses. During the bulk processing of the experiment data, corrections were made for angular aspect, sensor efficiency and mechanical backlash when the 512 step collimator changed direction. Also, the determination of the spectral range was inconsistent between forward and backward scans. Twenty parameters used in these correction and wavelength determination formulas were control card inputs. The CNST primary button when selected displayed the values of these 20 constants. The researcher could change one or more of them via the alphanumeric keyboard. If the COMPUTED primary button were then selected, it displayed another option secondary button, RE-COMPUTE. If this button were selected, the raw data for the sensor being displayed would be extracted from the random access file. Sensor correction for angular aspect would be recalculated along with the wavelengths using the same processing modules as in the batch processing program except with the newly defined constant(s). The new corrected sensor values were then displayed against the new wavelength range. Figure 7.6 shows the data from Figure 7.1 recalculated with a redefined backlash correction. Note that the wavelength scaling has been modified.

The fifth primary function of OGOGRAF was the ability to document procedures and results. In many instances the researcher could not compare results of analysis between scans or between displays before and after subtle changes in the correction parameters. The PLOT button allowed the researcher to create a 35MM film frame of the display at that moment. A 50-character message could be entered via the keyboard. This allowed for a permanent record of all pertinent stages of analysis and processing which could be further analyzed in the future or compared to results from prior graphics sessions. The figures used in this section are plots generated by the PLOT primary button.

The execution of program OGOGRAF requires that the file or files to be processed be stored as permanent disk files. Graphics application programs cannot request magnetic tape input. Following is the deck setup for processing a permanent file cataloged as GRAFDATA. Note that Graphics Programs must be submitted to be run on system A.

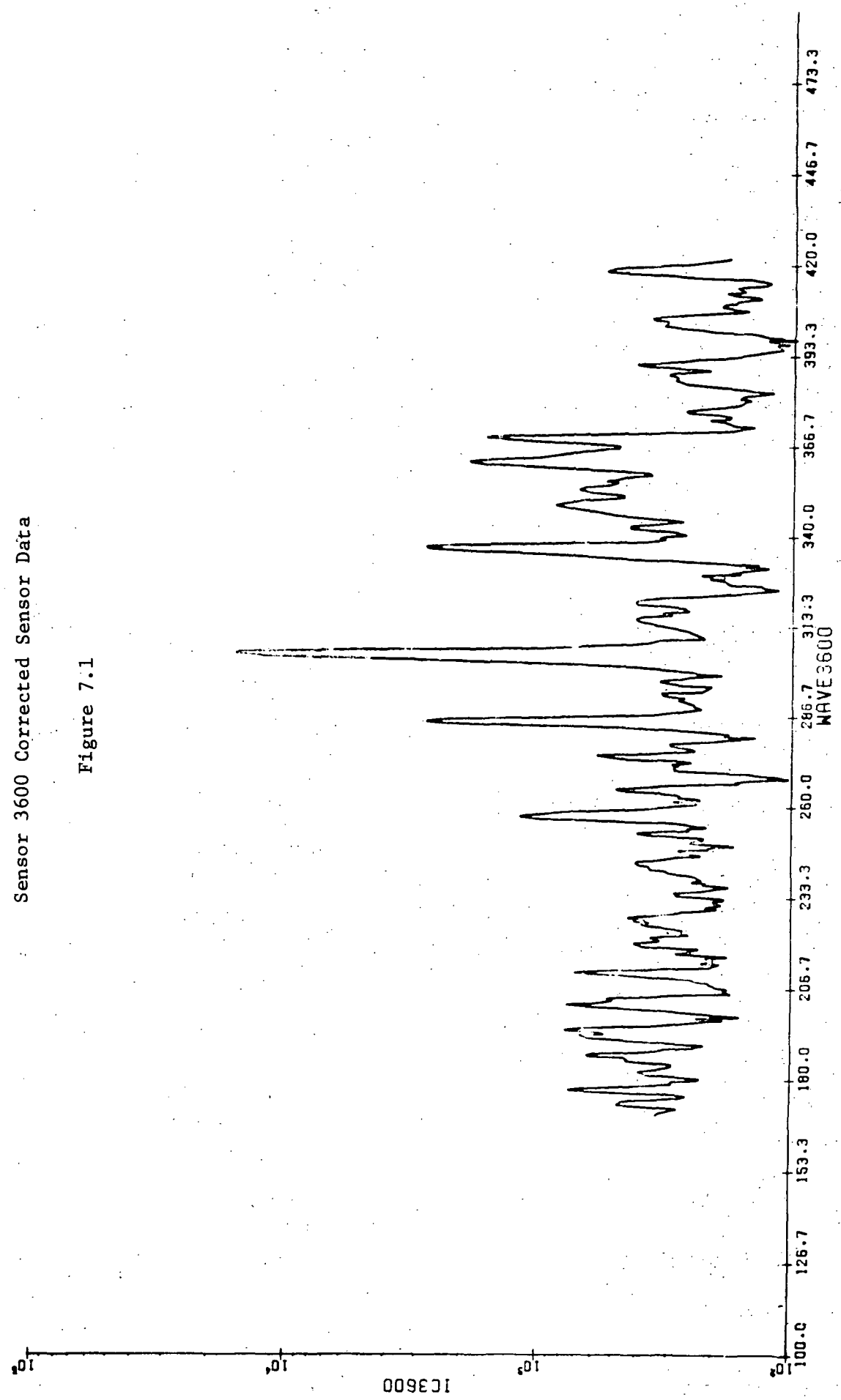
<u>Card</u>	<u>Description</u>
1	Orange 6600 Input Card (System A) Core Memory = 77K C.P. = 200 seconds P.P. = 500 seconds Plot = Write "Graphics Job" in special instructions box
2	DEL01, CM77777, T200. 7276 DELANEY
3	ATTACH, TAPE1, GRAFDATA, MR=1.
4	ATTACH, CRT, NEWONLINECRT, MR=1.
5	FTN, A, OPT=2.
6	COPYBR, CRT, LGO, 27.
7	FTN, A, OPT=2.
8	LOADER, PPLOADR.
9	NOREDUCE.
10	LOAD, LGO.
11	NOGO
12	NOREDUCE.
13	AEFILE, JT1, SOURCE.
14	SOURCE.
15	RELEASE, JT1.
16	EXIT.
17	EOR (7/8/9 in column 1)
18	THE OGOGRAF FORTRAN CARD DECK.
:	:
:	:
:	:
:	:
:	EOR
:	JT1
:	EOR
:	EOF (6/7/8/9)

N.B. All cards with the exception of those in the Fortran card deck begin in column 1. Punctuation must be followed. Interactive processing can begin when the tape and file prompter messages appear on the graphics console screen.

SCAN TYPE LONG BACKWARDS
 DATE 650300
 START TIME 42150
 STOP TIME 40100
 PLUT COMPUTED VALUES
 TAPE NUMBER 1507
 FILE NUMBER 91
 3600 SENSOR CORRECTED VALUES

Sensor 3600 Corrected Sensor Data

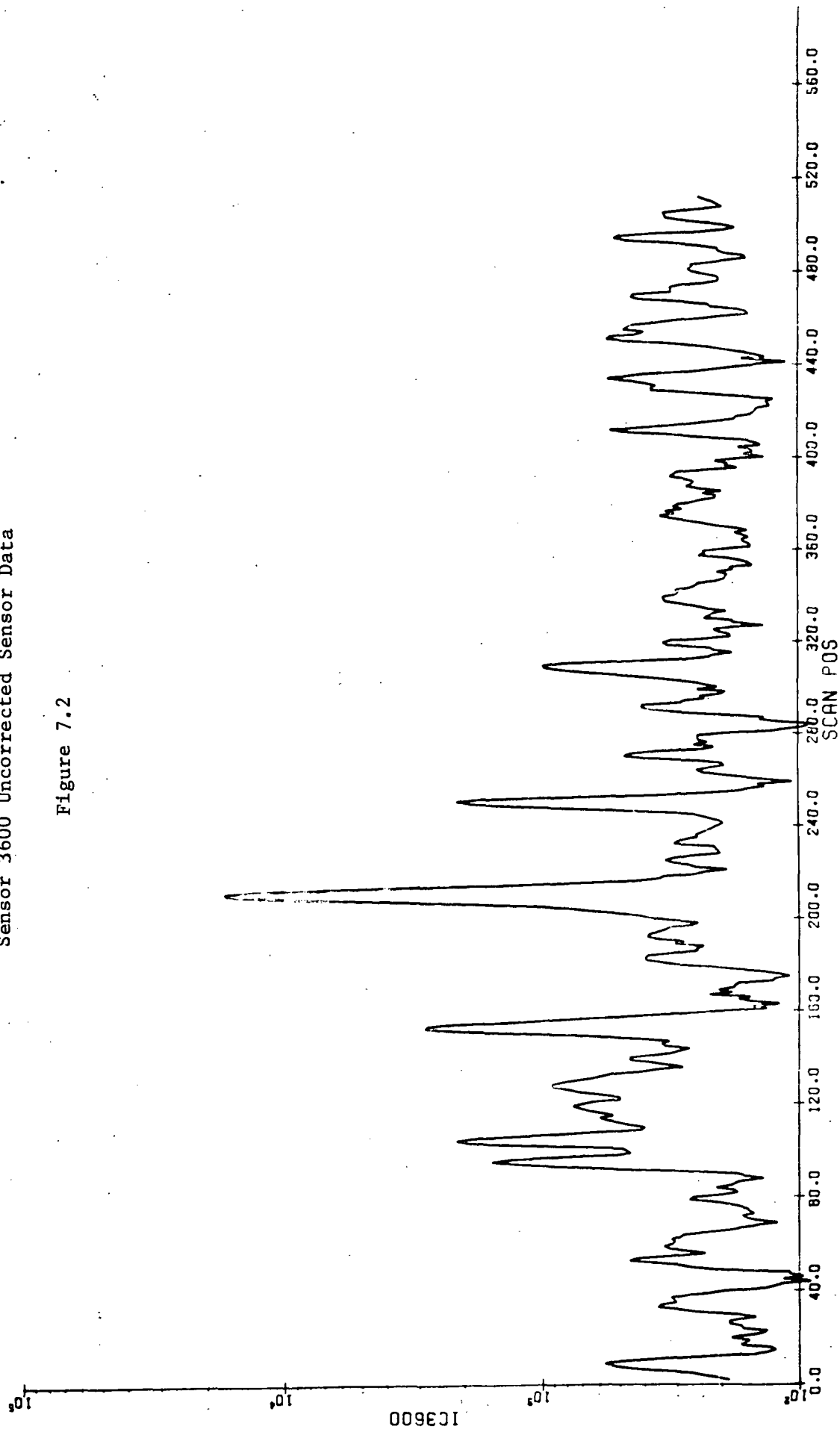
Figure 7.1



SCAN TYPE LONG BACKWARDS
 DATE 650610
 START TIME 42133
 STOP TIME 43120
 PLOT RM VALUES
 TAPE NUMBER 160/
 FILE NUMBER 11
 3600 SENSOR RAW DATA VALUES

Sensor 3600 Uncorrected Sensor Data

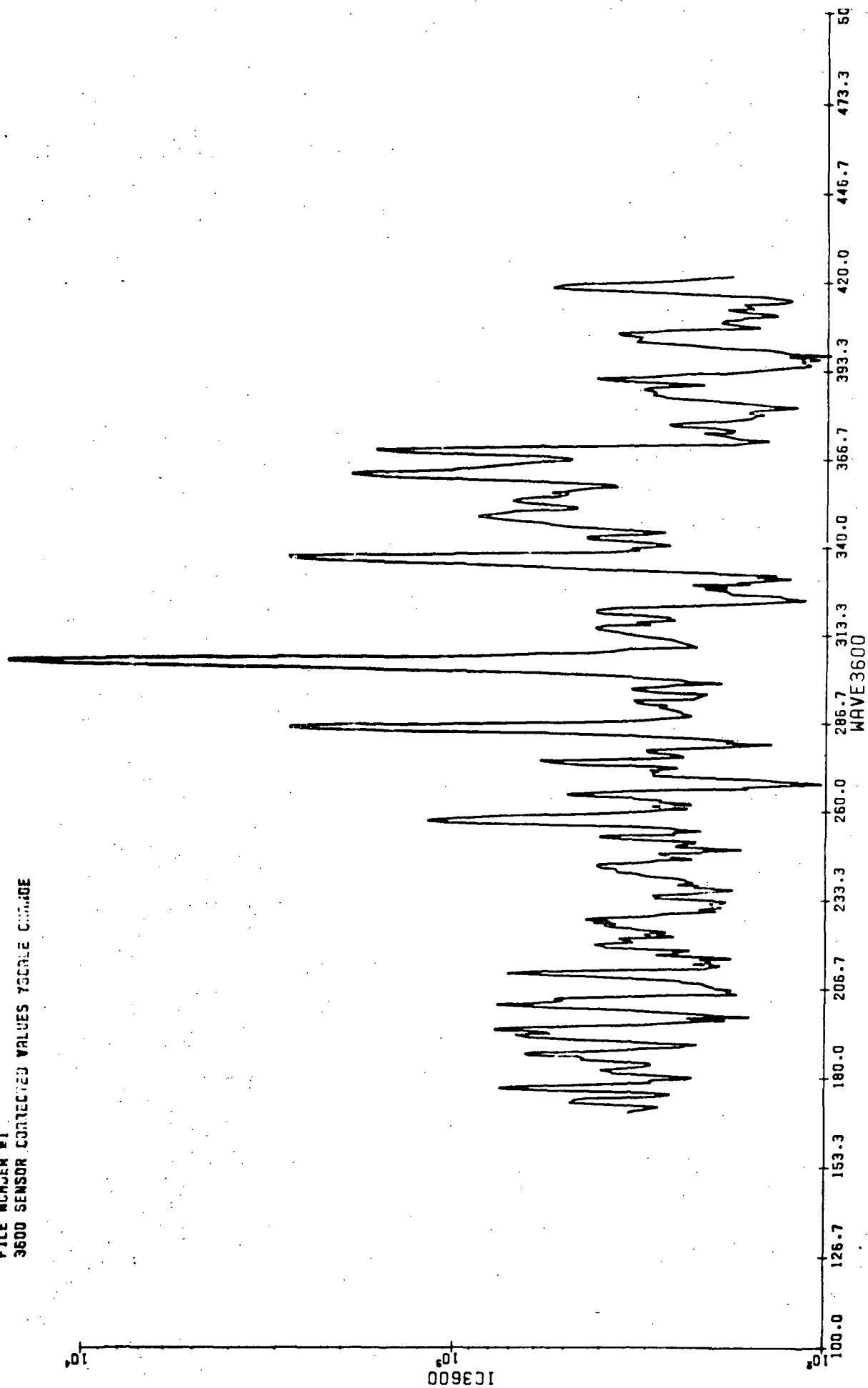
Figure 7.2



SCAN TYPE LONG BACKWARDS
 DATE 390610
 START TIME 42153
 STOP TIME 43120
 PLOT COMPUTED VALUES
 TAPE NUMBER 1607
 FILE NUMBER #1
 3600 SENSOR CORRECTED VALUES YSCALE CHANGE

Sensor 3600 Y-Scale Modification

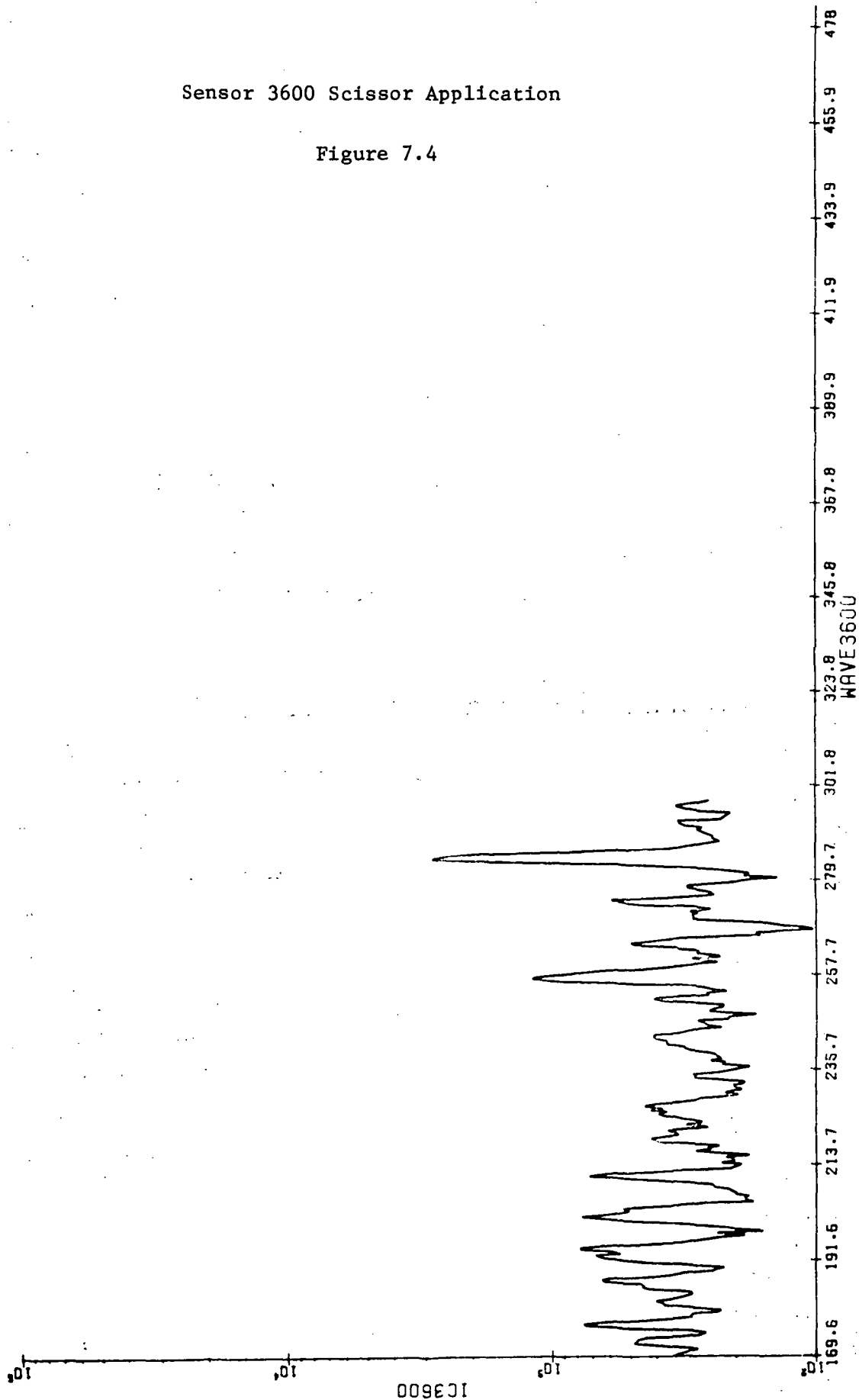
Figure 7.3



Sensor 3600 Scissor Application

Figure 7.4

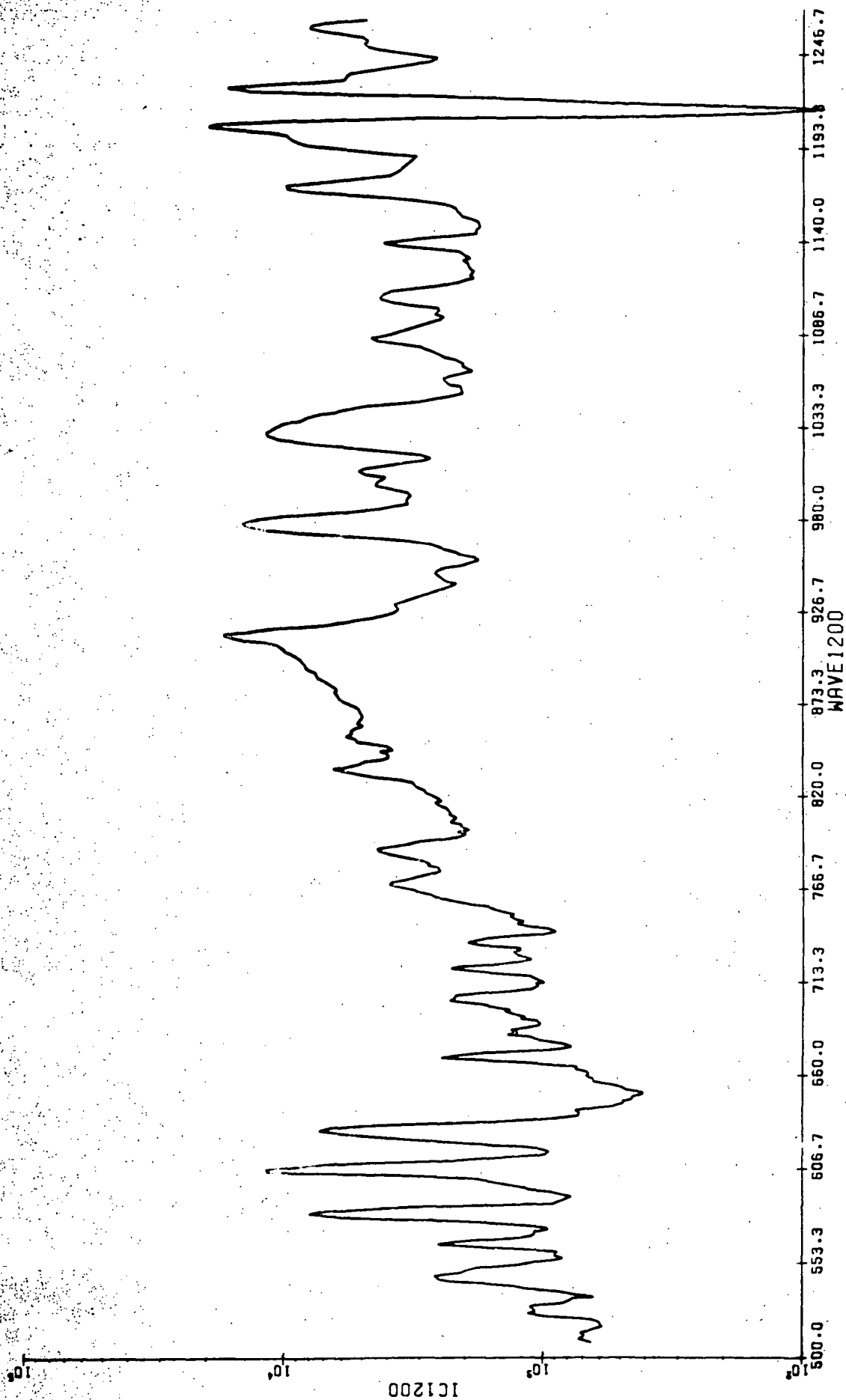
SCAN TYPE LOW BACKWARDS
DATE 690510
START TIME 42133
STOP TIME 43120
PLOT COMPUTED VALUES
TAPE NUMBER 1007
FILE NUMBER 01
3600 SENSOR CORRECTED VALUES CENSORED SIGNAL



SCAN TYPE LONG BACKWARDS
DATE 690610
START TIME 42133
STOP TIME 43120
PLOT COMPUTED VALUES
TAPE NUMBER 150/
FILE NUMBER 11
1200 SENSOR BEFORE BACKGROUND SUBTRACTION

Sensor 1200 before Background Subtraction

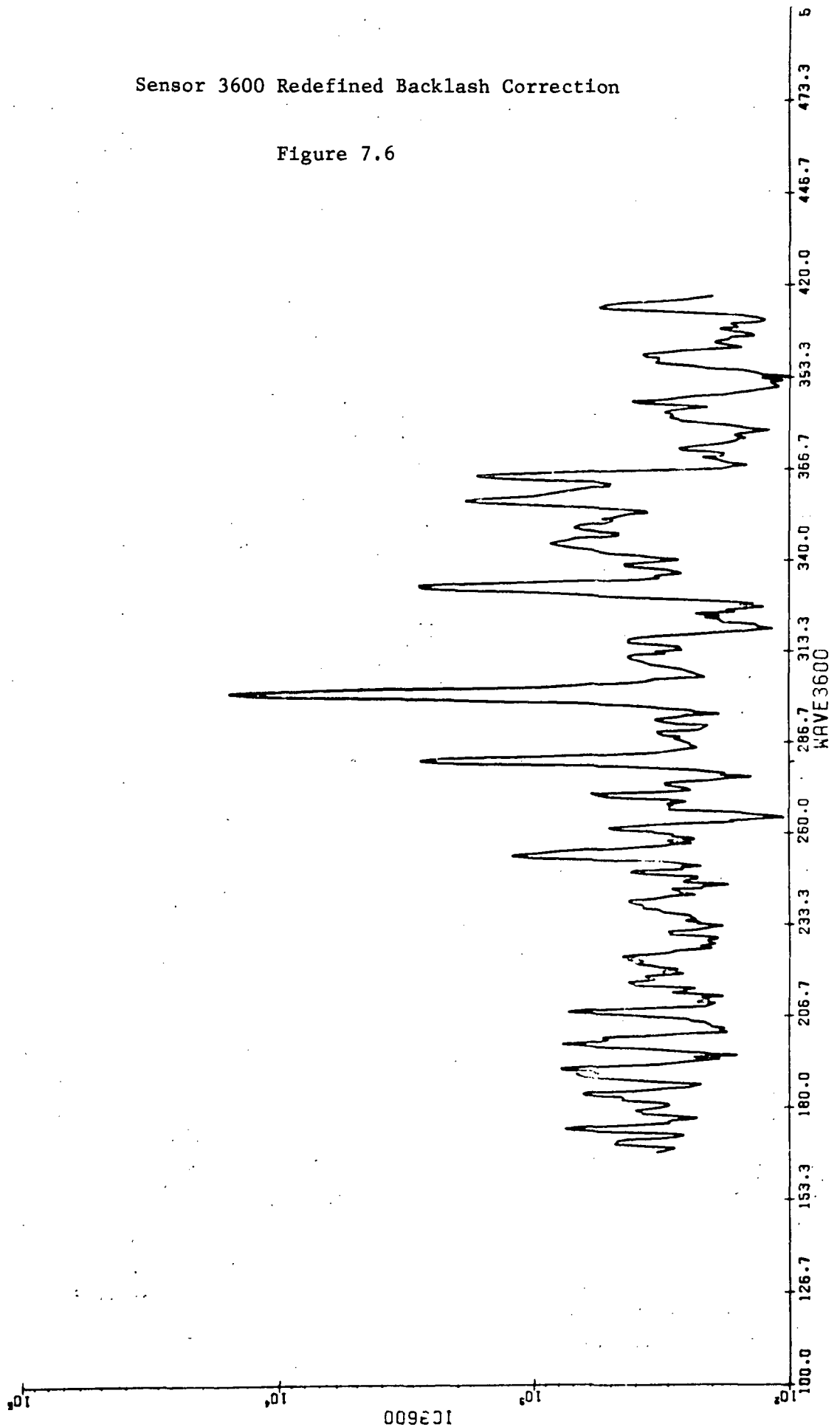
Figure 7.5



Sensor 3600 Redefined Backlash Correction

Figure 7.6

SCAN TYPE LONG BACKWARDS
 DATE 690510
 START TIME 42133
 STOP TIME 43123
 PLOT COMPUTED VALUES
 TAPE NUMBER 100/
 FILE NUMBER 21
 3600 SENSOR 43-22.7 BACKLASH CORRECTION



8.0 REFERENCES

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2. Wright, W. B. and Rutkowski, E. V., OGO Data Processing Programs, AFCRL-69-0156. Prepared for Contract Number F19628-68-C-0252, Scientific Report No. 1. Prepared for the Air Force Cambridge Research Laboratories, Office of Aerospace Research, United States Air Force, Hanscom Air Force Base, Bedford, Mass., May 1969.

9.0 RELATED CONTRACTS AND PUBLICATIONS

F19628-68-C-0349

F19628-70-C-0060

10.0 CONTRIBUTORS

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